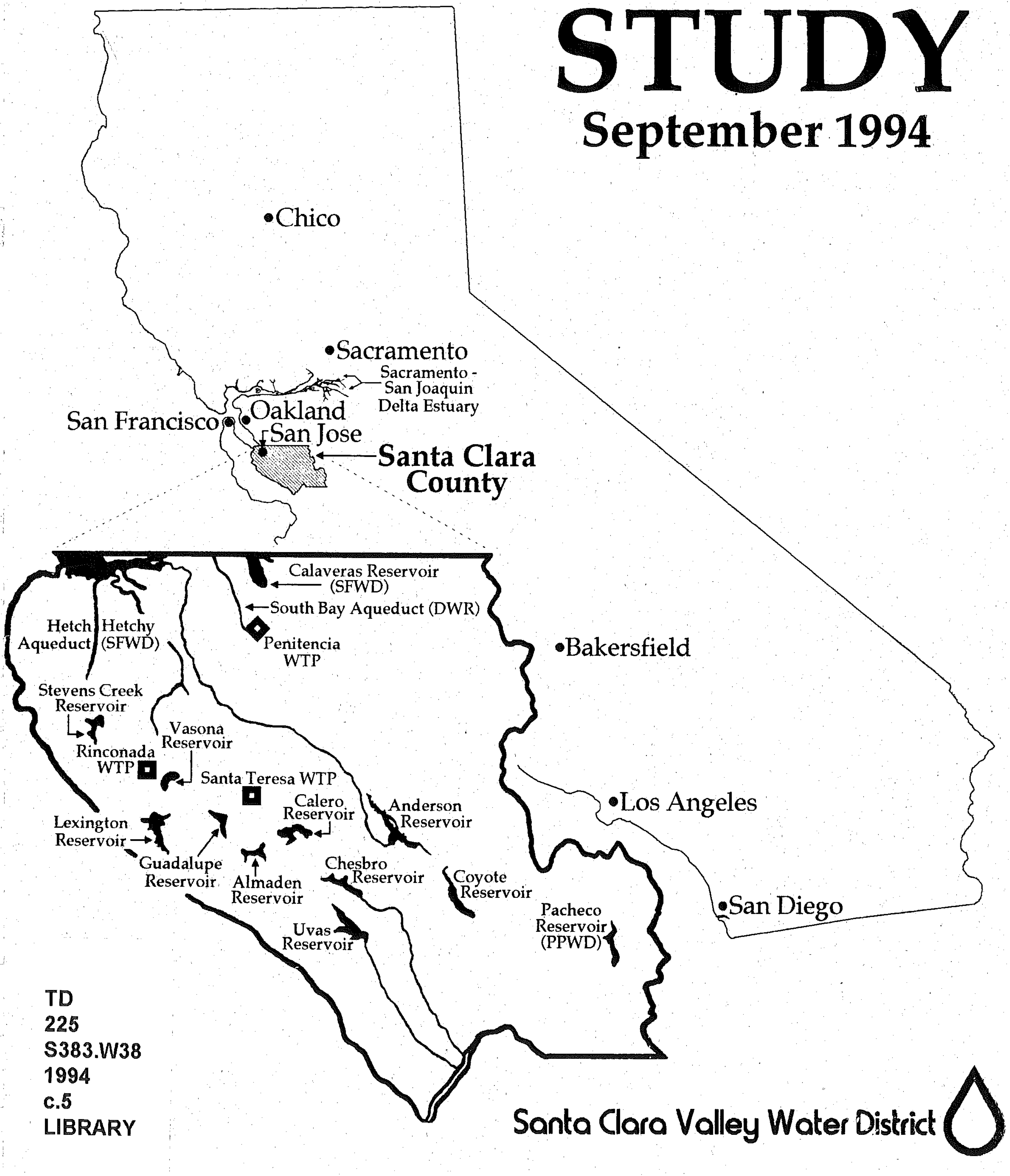
Water Supply
OVERVIEW STUDY

September 1994



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Santa Clara Valley Water District

Water Supply Overview Study

September 1994

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Chapter ①

Summary & Recommendations

Chapter 1
SUMMARY AND RECOMMENDATIONS

This study provides a broad, long-term planning framework for improving the reliability of the Santa Clara Valley Water District's (District) water supply and for identifying needed future studies and actions to be taken by the District. It identifies Santa Clara County's future water supply demands to the year 2020 and substantiates the need to augment current water supplies. It describes composite water supply alternatives to meet this need and examines some of the implications of these alternatives. This report also recommends that the District pursue an Integrated Resource Plan (IRP) to define the criteria for evaluating water supply alternatives. An Environmental Impact Report/Environmental Impact Statement (EIR/EIS) must be conducted before the District's Board of Directors makes specific decisions regarding development of new facilities.

BACKGROUND

Santa Clara County is one of nine counties that comprise the San Francisco Bay Area and is located at the southern end of the Bay. Over 1.5 million people reside within the county's 1,330 square miles. The county employs 800,000 people with 225,000 jobs in manufacturing. The County of Santa Clara ranks second in California and fifth in the nation in manufacturing as measured by the value of shipments. The high technology boom has spawned the term "Silicon Valley," by which the County is known worldwide. However, the silicon-based semiconductor industry is only a part of the industrial picture, with rapid increases occurring in information systems, personal computers, peripherals, instruments, and a wide array of defense-oriented electronics.

The water needs of residences, businesses, and agriculture within Santa Clara County reached almost 400,000 acre-feet in 1987. Sources of water include local groundwater and surface water, imported water from the State Water Project (SWP), the federal Central Valley Project (CVP), and San Francisco's Hetch Hetchy system, and reclaimed water. The District was created by the state legislature to manage the water supplies of the county and to wholesale these waters to both public and private retailers. Because of the changing water policy climate within California, the current water supplies of the county have been investigated to determine their adequacy.

The climatic, regulatory, and political forces which shape the availability of water throughout California are numerous and ever-changing, making it difficult to accurately forecast the availability and reliability of future water supplies for any of the state's water agencies. This climate of change is less predictable than the issues and challenges the District has dealt with in the past. In addition, external influences on the District's decision-making process have become considerably more numerous, varied, and complex. In particular, the rapid evolution of federal and state regulations to protect the Sacramento-San Joaquin Delta (Delta) and drinking water quality will have a major impact upon the District's ability to meet its water supply objectives. It is against this backdrop of complexity and uncertainty that the District has undertaken the crucial task of planning for Santa Clara County's future water supply.

The District's last major water supply plan was the "1975 Water Supply Master Plan," a document which identified the District's need for supplemental water and the facilities required to meet that need. Since then, the San Felipe Division of the CVP has become

DISTRICT MISSION AND GOALS

The mission of the District is to conduct a sound water management program that serves the community. This mission can be fulfilled through the accomplishment of these goals:

- ***Provide a supply of water, adequate as to both quantity and quality, needed to meet the desired quality of life in the community.***
- ***Provide protection against flooding in a manner that maintains the desired quality of life in the community.***
- ***Coordinate all other community water-related programs to achieve full water management.***
- ***Consider the community desires in all District programs and projects.***
- ***Protect the environment in the formulation and execution of District programs and projects.***
- ***Protect the economic well-being of the community in the formulation and execution of District programs and projects.***
- ***Fully implement water conservation best management practices.***
- ***Make full use of economically feasible local water supplies including reclaimed water.***
- ***Maximize the use of imported water deliveries.***

operational, major additions and improvements have been made to the District's distribution and treatment systems, and most of the programs identified in the 1975 Master Plan have been implemented.

If the planning assumptions for the 1975 Master Plan had remained as anticipated, the District's water supplies would be adequate to meet the county's water needs for the foreseeable future. But in the years since the Master Plan was adopted, the county has experienced two droughts, one of great severity over a short duration and one of moderate severity over a longer period; a major earthquake; a devastating fire in a major watershed; and 3 years of above-normal rainfall which resulted in 2 years of flooding in parts of the county. At the same time, federal and state requirements to protect the environment in the Delta have become more stringent, resulting in reduced deliveries of Delta water, and drinking water quality standards have expanded to encompass more contaminants with acceptable concentrations at lower levels.

This report evaluates these and other challenges facing the District. It identifies alternatives that could meet the water needs of the county, and describes an action plan for selecting and implementing these alternatives. A summary of the report contents follows.

REPORT SUMMARY

The District's Water System

The District operates a system of reservoirs that store local runoff, groundwater recharge facilities that subsequently percolate these waters, conveyance pipelines, pumping plants, and water treatment plants (WTPs) to treat raw water for potable use. The components of the District's water supply system are vulnerable in varying degrees to earthquakes, flooding, contamination, and regulatory restrictions. These risks affect the District's operational reliability and must be taken into account in the evaluation and selection of options for supplementing the District's water supply. Emergency preparedness planning and the investigation of facilities to provide system redundancy and emergency water supplies is essential.

Drinking Water Quality Issues

Imported water delivered to the District is transported through the Delta. Delta water can be saline, depending on levels of seawater intrusion, and contains relatively high concentrations of organic matter from tributary rivers and agricultural drainage. When treating Delta water with chlorine disinfectants, unhealthy by-products can result. Some of these disinfection by-products (DBP) are suspected to cause cancer.

The Safe Drinking Water Act Amendments of 1986 (SDWA) have resulted in several new water quality regulations. These regulations include the Disinfectants/Disinfection By-Products (D/DBP) Rule, the Surface Water Treatment Rule (SWTR), the Lead and Copper Rule, and the Total Coliform Rule.

The D/DBP Rule will have far-ranging impacts on the District's water utility. These impacts are directly linked to the poor quality of the Delta water that is delivered to the District for treatment: poor-quality water leads to higher levels of DBPs. The D/DBP Rule will probably require major modifications of District treatment plants at a substantial cost. Meanwhile, the District, along with other water agencies throughout the state, is responding to the issue by advocating the development of reasonable water quality regulation, working for the improvement of Delta water quality through operational changes and construction of facilities, and investigating ways to improve or add new water treatment processes. The District may be required to spend more than $100 million to meet the D/DBP Rule by constructing alternative disinfection facilities at its three WTPs.

Other rules are currently being considered which would not directly affect District operations but would raise significant compliance issues for water retailers in the county. These include the U.S. Environmental Protection Agency's (EPA) proposed Groundwater Disinfection Rule (GWDR), which may require disinfection of all source water from wells, and the EPA's proposed Radionuclides Rule, which would set maximum levels for radon in drinking water wells.

The County's Water Needs

The District estimates that Santa Clara County's 1994 annual water use for residential, industrial, and agricultural needs is about 425,000 acre-feet (af). However, in response to the drought over the last 5 years, the District and the water retailers of the county have implemented mandatory water use reduction programs that have reduced this total water use by more than 25 percent in certain years. Although mandatory water use reductions are not currently in effect, residual water use reduction is occurring.

For projecting future water needs, the District utilizes a water demand estimating model. The water need at the build-out of the county, or year 2020, is estimated at 515,000 af. These demand projections represent the demand expected under average weather conditions if no conservation efforts are taken beyond the savings of 28,000 af expected from plumbing code changes regarding low-flow fixtures. For very wet and very dry weather conditions, the total demand projection ranges from 495,000 to 537,000 af.

Existing Water Supply

- *Local Supplies*—The local supply of water depends upon local rainfall. The median annual rainfall in the San Jose area is approximately 13 inches; however, not all of this rainfall is stored for consumptive uses—a significant portion of local runoff flows to the San Francisco Bay or the Monterey Bay.

The District's reservoirs and percolation facilities capture and store, on the average, about half of the surface flows of the county's major watersheds. Rainfall is also captured by natural seepage into the groundwater basin. The captured surface flows and natural groundwater recharge combine to supply the county with about half of the supply required to meet current water needs.

Other agencies have also developed water locally. One of these is San Jose Water Company which has developed local runoff by capturing and storing it in their Elsman Reservoir for which they have an appropriate water right of over 6,000 acre-feet per year. Local cities have developed approximately 1,000 acre-feet of reclaimed water for nonpotable applications with projects being planned to develop a much greater amount.

IMPORTED WATER LIMITATIONS
Imported water is a critical component of the supplies for the county but these imported supplies will never deliver their full entitlement because of the restrictions imposed upon the pumping of water by the SWP and the CVP to proect the environment within the Delta.

- *Imported Supplies*—Santa Clara's first imported water was provided under specific contracts to some of the North County cities in the 1960s from the Hetch Hetchy Aqueduct owned and operated by the City and County of San Francisco. As the valley's population grew, more imported sources were needed and the District obtained contract entitlements from the SWP and the CVP. These entitlements have become vital to meeting the county's water needs. Today, reliability of supply from the SWP and CVP is in question.

This study reviews in detail the limitations on SWP/CVP exports and indicates the amount of water available due to variations in hydrology and the environmental requirements of the Sacramento/San Joaquin Delta and San Francisco Bay estuary. The District, in order to plan and prepare for the possibility of reduced SWP and CVP supplies, has relied on work by the State Department of Water Resources (DWR) to analyze water supply availability. This study reflects the EPA requirements on how the Delta and the state and federal water projects would be operated in the future to accomplish proposed water quality objectives and fishery enhancements. In summary, this study projects that the District can never expect to receive 100 percent of its entitlements, can expect to receive 70 percent of its entitlement in average years, and can expect only 40 percent of its entitlement in critical dry years.

As for water imported from the Hetch Hetchy Aqueduct, this supply is also not reliable during periods of drought. Hetch Hetchy may also have to contribute some portion of its supply to the Delta and/or to mitigation of other downstream impacts.

Projected Water Supply

Projecting the District's future water supply involves many uncertainties. The current statewide drought poses the most serious prediction problems with regard to duration and severity. We can expect a drought to end, but when? And how long will the respite from a drought be? Other circumstances that affect the District's water supply include changing federal and state regulations governing imported water supplies; more stringent federal and state drinking water quality regulations; and exposure of District facilities to the risks of earthquakes, hazardous chemical spills, chemical contamination, and other such disruptions to the water supply system. One certainty is this: to satisfy the existing and projected water needs in Santa Clara County, it will be necessary to supplement the existing water supplies with additional sources.

In light of these uncertainties, the reliability of the District's water supply must be addressed. Supply reliability depends on the antecedent conditions before the drought commences and the system's storage capacity, the severity of the supply during the drought, the time length (duration) of the drought, and the occurrence or frequency of the drought event. Together, these criteria can be used to determine the dry period that is likely to occur and that the District's facilities should be designed for: the critical dry period.

FOUR MAJOR ATTRIBUTES THAT EFFECT THE SEVERITY OF A DROUGHT:

- ***Occurrence—The frequency with which drought events reoccur.***
- ***Antecedent Conditions—The amount of water supply available to a system before entering into a drought.***
- ***Supply Severity—The amount of water supply that is generated during the drought.***
- ***Storage Capacity—The system's ability to store water that will be used during the drought period.***
- ***Duration—The length of time the drought lasts.***

To determine the critical dry period for the District's system, District staff reviewed the hydrological information available and compared the most severe droughts recorded over multiple-year time periods. The duration of a reasonable design critical dry period depends upon the storage capacity of the system; for the District's system, this was determined to be 10 years. The 10-year duration extends the drought to a point where recovery of the system's storage takes place; this is done to verify that the worst point of the drought has been overcome. The severity for the critical dry period was determined to be 1-in-100. The 1-in-100 severity level was used because it represents a reasonable severity that has been observed in the historical past. From all of the 118 events, seven major droughts, which have lasted from 1 to 10 years, have occurred and four of these droughts have had a severity greater than 1-in-100. However, a drought of greater severity is possible, and were it to occur, facilities designed for the 1-in-100 severity level would be inadequate to meet the county's water supply needs.

Potential Water Shortages

If measures are not taken to develop additional water supplies for Santa Clara County and the most stringent of the proposed standards to regulate deliveries from the Delta are adopted, during a critical dry period the county could suffer an estimated maximum water shortage of 247,000 af/year for the year 2020. If a proposed CVP Municipal and Industrial (M&I) Shortage Policy is adopted, the maximum 2020 water shortage during a critical dry period would be 175,000 af/year.

MAXIMUM WATER SHORTAGE ***The estimated maximum shortage that the county could experience in year 2020 is 175,000 af/year during a critical dry period, with the CVP M&I shortage provisions implemented, which could occur 25 percent of the time and some form of shortage could be expected 63 percent of the time. By the year 2000, this estimated maximum shortage could reach 92,000 af/year.***

Significant water shortages could again happen even sooner than the year 2020. The maximum water shortage during a critical dry period for the year 2000 is estimated to be 108,500 af/year; if the CVP M&I Shortage Policy is adopted, this shortage would be 71,000 af/year.

The projected water supply and shortages are those which **might** occur during a critical dry period, not what necessarily **will** occur. However, maximum shortages are not rare occurrences. Based on past hydrologic trends, and given the year 2020 demand forecast, the adoption of the EPA standard governing Delta exports, and implementation of the M&I Shortage Policy, the maximum shortage could be expected to occur 25 percent of the time and some form of shortage could be expected 50 percent of the time.

Components for New Water Supplies

District staff investigated a number of possible water supply components that could help the District's system withstand these projected water shortages. Various water supply components, combined into alternatives for meeting the county's water needs, were grouped by their functional impact: demand-side management (DSM), new sources of supply, supply-side management, and system operation management.

- *Demand-Side Management*—DSM methods include efficient water use programs, short-term demand reductions, and land use controls that limit new water demands. The efficient water use programs include the Best Management Practices (BMPs) of outdoor water audits, retrofits of showerheads and low-flow toilets, landscape ordinances, and commercial and industrial indoor audits. This program has been authorized by the District Board of Directors (Board) to continue in the future. These efficient water use programs will also serve to "harden water demand" thereby diminishing a water users' ability to comply with short-term water use reductions. The same level of hardship that has been imposed upon the county during this last drought is anticipated to only yield 10 percent short-term water reductions in the future. Finally, the policy of the District is to meet all water needs of the county and not to preclude development from occurring through land use controls.

- *New Sources of Supply*—Many new sources of supply options are available for meeting the county's water supply shortage. The District and/or local agencies could develop reclaimed water for nonpotable use, recharge reclaimed water for potable use, or export reclaimed water to the Delta or San Joaquin Valley in exchange for other water sources. The District could arrange for CVP or SWP water transfers from project contractors or independent agencies. The State Drought Water Bank could become a resource for water transfers to the District in the event of a critical dry year. Development of a desalination plant is another option, as is the application of gray water for residential landscape irrigation. The District could also increase local water yields by augmenting local reservoir storage and/or recharge capacity within the county.

- *Supply-Side Management*—There are many options available to manage the District's supplies differently that would help meet the county's future water supply needs. These options would affect facilities both within and outside the county. The District could expand the capacity of the existing Rinconada WTP. The District could also build a new South County WTP or additional recharge facilities in the southern part of the county. Additional groundwater storage beyond the current operational storage range could be used, but at the risk of ground surface subsidence. There are several options available to increase surface water storage. In-county storage could be increased by expanding Anderson Reservoir or building a new in-county reservoir. Participation in the Los Banos Grandes Reservoir project, an Upper Del Valle Reservoir project, or a water banking program with an entity outside of the county are some other ways to provide additional storage to the District.

- *System Operation Management*—Reprioritizing the use of the District's various water supplies has many benefits and some inherent risks. Utilizing the SWP and CVP deliveries over local water will assure greater imported water use over a wider range of hydrologic conditions and provide carryover storage of local water in District reservoirs; however, this operational modification may increase the potential for localized flooding or spillage of local runoff to San Francisco Bay.

  CVP deliveries can be used before SWP supplies to reduce supplemental supply requirements during a drought. However, on the long-term average, some SWP deliveries will be displaced. The displaced SWP water can be "wheeled" by way of the CVP's San Felipe Project through the south end of Santa Clara County and placed in short-term storage in Anderson or Calero Reservoirs or delivered to District percolation or WTP facilities.

  Another operational modification is for the District to become the master contractor for Hetch Hetchy water that is now supplied to various North County cities under independent contracts. This could increase the long-term reliability of the county's water supplies, facilitate the transfer of water between the District and the San Francisco Water Department (SFWD), and increase operational flexibility in meeting the county's future water supply needs. However, the District's role as a Hetch Hetchy master contractor depends upon limitations contained in federal legislation (the Raker Act) and clauses in the suburban contractors' delivery contracts.

Water Supply Alternatives

The District has identified several alternatives that attempt to meet the county's total supplemental water needs for the year 2020. These alternatives combine components from the four major categories of demand-side management, supply-side management, facility additions and modifications, and system operation modifications. Each of the alternatives either meet the 2020 water needs of the county or has mandatory reductions that must be imposed during a drought. These alternatives represent reasonable combinations of components but may not represent all combinations. Other combinations can be made to form different alternatives and may have to be investigated in the future.

A key premise of these alternatives and the overall study is that the District will continue to place a high priority on maximizing savings from permanent water conservation as a cost-effective, environmentally-sensitive partial solution to the county's long-term water supply deficiencies. (In August 1991, the District signed a Memorandum of Understanding for Water Conservation (MOU), thereby joining over 80 other water agencies throughout California committed to aggressively promoting water conservation BMPs.) Each alternative assumes that the water conservation BMPs, as stipulated in the MOU, will be realized and that more than 28,000 af/year in permanent water use reduction will be achieved by the year 2000 and a total of 45,000 af/year by the year 2020.

All of the alternatives except one anticipate the development of nonpotable reclaimed water. The District will not have direct control over this component but will depend on the wastewater agencies to develop this supply. The District anticipates that 32,000 af of nonpotable reclaimed water will be developed by 2020.

Integrated Resource Planning

Adequately evaluating the water supply alternatives available to the District will require a planning process that involves the community and develops consensus among various interests. This process is known as an Integrated Resource Plan. The IRP process offers the District an opportunity to involve various community stakeholders in the selection of water supply alternatives that will alleviate the county's projected water shortfall. The process should involve the community in planning, decision making, and implementation, with the goal of developing consensus for a future water supply alternative. The District would act as technical advisor and facilitator for this process, rather than as an advocate for a single alternative.

Through the IRP process, various community interests work together to develop screening criteria for evaluating supply alternatives. The screening criteria would be used to select alternatives for further study in an EIR. These criteria could address such factors as water supply and water quality reliability, vulnerability to regulatory changes, costs, environmental concerns, institutional considerations, technical feasibility, and public acceptance.

RECOMMENDED ACTIONS

Based on current and projected local and imported water supplies and an estimate of anticipated imported water supply reductions, the District's present supplies and facilities will not be able to meet the water supply needs of the county during a critical dry period. Considering the incompleteness of the SWP, the anticipated reductions in imported water supplies of the SWP and CVP resulting from the EPA's decision and recent federal legislation, the desire for Santa Clara County to maintain its industrial base and its residential and commercial quality of life, and the District's need for long-term predictable water utility revenues, District staff recommends the following course of action:

1. **Establish Need**

   District staff believes this report establishes the need to augment the current water supplies of the county. This report should be disseminated to the District's water retailers, local and county governments, environmental groups, the media, and concerned citizens for their comment.

2. **Involve the Community**

   Organize a citizen's group that represents the various interests of the community to provide the District with diverse voices and to identify their values related to water supply alternatives.

3. **Develop Alternatives**

   This report has documented the evaluation of different alternative combinations to meet the future water needs of the county. Additional resource alternatives may have to be developed as the IRP process evolves.

4. **Establish Screening Criteria**

   With the participation of all groups, develop screening criteria that will be used to objectively evaluate the numerous alternatives that can meet the level of service required.

5. **Screen Alternatives**

   Using the criteria that are established screen the alternatives to select those that will be evaluated in an EIR/EIS process.

6. **Build Board Consensus**

   Keep the District's Board of Directors abreast of the progress of the project and build consensus with them on the preferred alternative throughout all of the steps taken.

7. **Undertake an EIR/EIS**

   The purpose of the EIR/EIS is to inform decision makers and the public about a project's significant environmental effects and ways to reduce them, demonstrate to the public that the environment is being protected, and ensure political accountability by disclosing to citizens the environmental standards held by their elected and appointed officials. Developing consensus in the IRP process should make this effort much easier. However, the entire environmental clearance and permit process usually takes a minimum of 2 to 4 years.

8. **Implement the Preferred Alternative**

   After all of the above steps are taken, the preferred alternative can be implemented.

Success in this endeavor is critical. The quality of life for succeeding generations in our valley will be affected by how these challenges are addressed.

Chapter 2

Introduction

Chapter 2
INTRODUCTION

This chapter explains why the overview study has been undertaken and provides a summary of the contents of this report.

NEED FOR STUDY

In 1975, the District completed a Water Supply Master Plan and EIR for the District's water utility. That document quantified the need for supplemental water to meet the county's long-term water needs and recognized the San Felipe Division of the U.S. Bureau of Reclamation's CVP as the best source of supplemental water. The plan also identified the in-county distribution system facilities needed to maximize the use of the San Felipe Division water and other available water supplies while minimizing costs.

The San Felipe Division facilities have been constructed and began delivering water to Santa Clara County in June 1987. Concurrent with construction of the San Felipe Division and consistent with the 1975 Master Plan, the District's in-county distribution system was also expanded to best incorporate San Felipe Project waters into the District system.

AN UNPREDICTABLE AND COMPLEX SET OF CHALLENGES
One unifying theme of the changes facing the District is that they are less predictable than the issues, problems, and challenges the District has dealt with in the past. The external influences and factors to be considered in the decision-making process have become considerably more varied and complex. In particular, the rapid evolution of stricter drinking water quality regulations and federal and state regulations to protect the environment of the Delta will have a major impact upon the District's ability to meet its water supply objectives.

If the planning assumptions for the 1975 Master Plan had remained as anticipated, the District's water supply and its facilities would be adequate to meet the county's existing and projected water needs for the foreseeable future. However, several unforeseen circumstances have developed since the 1975 Master Plan which threaten the adequacy and reliability of the county's water supply. These include the following:

- Supplies from the San Felipe Division which could have been recharged and carried over in the groundwater basin were not available as early as anticipated.
- Availability of the District's full contract amount of imported SWP water (100,000 af/year) and CVP water (152,500 af/year) has become uncertain and has not been realized in the last few years due to increasingly stringent protection measures for the environment in the Delta.
- More stringent federal and state regulations related to drinking water quality have emerged; these encompass more contaminants and lower levels of acceptable concentrations.
- The exposure of District facilities to the risk of earthquakes, hazardous chemical spills, chemical contamination, and other supply disruptions has grown.
- The drought of the last few years that has set record low rainfall totals for 3, 4, and 5-year drought durations.

This dynamic new environment cannot be controlled by the District. Instead, it must be considered and integrated into the District's future course of action. Strategies, structures, and systems developed today must have the flexibility to anticipate and accommodate the changes of tomorrow. Thus, the water supply planning process must focus extensively on assessing and comprehending the emerging external environment.

WATER SUPPLY SOLUTION
The solution to meet the water supply needs of the community will require a comprehensive approach that incorporates many objectives and builds consensus on the objective that conflict.

This report represents a focus point for this effort. It identifies the numerous challenges and problems facing the District, describes alternatives that could meet the county's water needs, and outlines the actions that must be taken to implement a water supply solution. Developing this solution will require a comprehensive approach that incorporates many objectives—reliable water service, water reuse, conservation, reliable water quality, and environmental protection—and considers all direct and indirect costs and benefits of various water supply options. The process should involve the community in planning, decision-making, and implementation, with the goal of developing consensus for future water supply alternatives.

This document will be used to establish the need to augment the current water supplies to the county and to inform the District's advisory committees, water retailers, and the community of this need. Any action taken or decision made, such as the construction of new facilities, will be based on additional studies and environmental review needed to comply with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA).

REPORT CONTENTS

This study contains 13 chapters. The following two chapters provide technical background that serves as a foundation for understanding subsequent discussions of District facilities and water supply issues. Chapters 5 through 11 establish the county's water needs, water supplies, and potential shortages, and describe various options that can be combined into an alternative for meeting the water needs of the county. The penultimate chapter serves as a summary of the planning assumptions contained in the report, and the final chapter describes a planning process the District could use to facilitate development of a water supply alternative. A more detailed chapter-by-chapter description follows:

- Chapter 1 provides a summary of the report findings and recommendations for action.

- Chapter 2 (this chapter) describes the need for the study, its organization, and its contents.

- Chapter 3 provides an overview of the development and operation of the District's water supply system and examines operational reliability and constraints for each system component.

- Chapter 4 describes the drinking water quality regulations facing the District, the challenges they impose, and the physical/operational modifications or additions needed to meet these challenges.

- Chapter 5 reviews the county's water needs. The forecast for the county's water needs to the year 2020 is described, as is the methodology behind these projections. This chapter also describes how this forecast differs from the water use projections that were developed in the District's 1975 Master Plan.

- Chapter 6 examines the county's water supplies. It discusses the water supply design criteria the District developed to plan for dry periods and analyzes the amount of water available from existing local and imported water supplies. This chapter concludes with an estimate of the imported water deliveries the District can expect from the Delta under various regulatory and hydrological scenarios.

- Chapter 7 uses the water needs and supply data established in previous chapters to characterize the potential water shortages that could occur if no actions are taken to expand the county's water supply.

- Chapter 8 provides a brief overview of demand-side management methods, including efficient water use programs, short-term water use reductions, and land use controls that limit new water demands.

- Chapter 9 describes the new sources of supply options that can be used to meet the water supply shortage of the county, including potable and nonpotable water reclamation, water transfers, the State Water Bank, desalination, gray water, and increasing local yield.

- Chapter 10 describes the supply-side management that could be developed to increase supply reliability. These include enlarging existing local reservoirs, overdrafting the groundwater basin, exploring groundwater storage options in the Central Valley, and building a new reservoir either in-county, at Los Banos Grande near the SWP, or at Upper Del Valle. The expansion of existing treatment plants and the construction of a new treatment plant are also discussed.

- Chapter 11 describes the District's existing operational priorities and identifies modifications to current operations that could provide additional supply reliability for the county. These modifications include using imported water before local water, using CVP water before SWP, and storing imported water in local reservoirs. This chapter concludes by exploring the water supply benefits and legal issues related to the District becoming the master contractor for Santa Clara County's Hetch Hetchy water supply.

- Chapter 12 summarizes the planning assumptions made for this study. It also describes the numerous combinations of water supply options that could achieve the county's water supply goals.

- Chapter 13 describes the Integrated Resources Planning process and explains how the District can use it to facilitate the development of a water supply project. It summarizes the need for additional water supplies to provide for the county's anticipated shortfall, suggests screening criteria that must be developed to evaluate various water supply alternatives, and concludes with a brief outline of the steps involved in the IRP process.

Chapter 3

System Overview

Chapter 3
SYSTEM OVERVIEW

This chapter provides an overview of the development and operation of the District's water supply system and examines operational reliability and constraints for each system component. The information in this chapter serves as a foundation for understanding the water supply issues that are discussed in this report.

A BRIEF HISTORY

The District's Origins

The District traces its origins to the severe drought of 1927 to 1934. Overdraft of the groundwater basin during this drought resulted in land surface subsidence in the northwest areas of the county. Subsidence in the baylands of Alviso and in San Jose damaged buildings and roads, increased vulnerability to flooding, and raised awareness of the need for countywide water supply management. In 1929, county voters approved a ballot measure which created the Santa Clara Valley Water Conservation District. In 1951, the state legislature created a special district with authority for both water supply and flood control activities, and in 1968 the water conservation district and this new special district merged. The resulting organization later named itself the Santa Clara Valley Water District.

Meeting the Needs of a Growing County

The water conservation district built six dams in 1935 to capture local winter water for recharge into percolation facilities during the summer. These reservoirs, in conjunction with local groundwater supplies, satisfied the county's water needs through the 1950s. But between 1950 and 1965, the county's population more than tripled and local supplies became inadequate. The District began working to secure water from outside of the county and to develop water treatment plants (WTPs) for supplementing groundwater supplies.

In 1956, the San Francisco Water Department (SFWD) completed the Bay Crossing Pipeline No. 3 around the northern part of the county, making Hetch Hetchy water available on a direct contract basis to North County cities. Hetch Hetchy water originates from a reservoir located within Yosemite National Park. In 1965, the District began receiving deliveries of water imported from the SWP. This water originates in the Sierra Nevada mountains, flows down the Sacramento River through the Sacramento-San Joaquin Delta, and is pumped from the Delta through the South Bay Aqueduct (SBA) into the northeastern part of Santa Clara County. A third source of imported water is the San Felipe Division of the federal CVP, which began delivering water from the Delta to Santa Clara County in 1987.

As it became apparent that the county's groundwater basins could not be developed sufficiently to recharge all of the imported water needed to meet the county's future potable water demands, the District began planning and building WTPs. These plants treat a portion of the imported water for potable use. Both the Rinconada

WTP, which began operating in 1967, and the Penitencia WTP, which began operating in 1974, treat water imported from the SWP. The Santa Teresa WTP, which began operating in 1989, treats water imported from the CVP.

Figure 3.1 illustrates the District's water conveyance, treatment, and distribution system.

***RELIABILITY:
LOCAL RESERVOIRS***

In the late 1970s and early 1980s, the District's dams were reanalyzed in accordance with the state-of-the-art methodology. All of the dams except Stevens Creek met the standards. The water level in Stevens Creek Reservoir was brought down and the dam was modified by adding upstream and downstream berms, at a cost of $2.6 million. Today, all of the District's dams meet current earthquake safety standards as determined by the Division of Safety and Dams.

The spillways at both Anderson and Coyote dams have been reconstructed to meet the maximum probable flood that could occur in their watershed. Lexington's spillway is currently under investigation and will require some modifications to pass the maximum probable flood.

LOCAL RESERVOIRS

The District operates and maintains a countywide conservation and distribution system to convey raw water for recharge and treatment. Included are ten local reservoirs which conserve local runoff for either recharge or treatment at one of the District's three WTPs. The total storage capacity of these reservoirs is 169,000 af. Table 3.1 lists their significant features.

**TABLE 3.1
District Reservoirs
Significant Features**

Reservoir	Capacity (acre-feet)	Year Completed	Surface Area (acres)	Dam Height (feet)
Almaden	1,780	1935	59	105
Anderson	89,073	1950	1,244	240
Calero	10,050	1935	347	98
Chesbro	8,086	1955	265	95
Coyote	22,925	1936	638	120
Guadalupe	3,740	1935	79	129
Lexington	19,834	1952	404	195
Stevens Creek	3,465	1935	92	120
Uvas	9,950	1957	286	118
Vasona	400	1935	58	30

FIGURE 3.1
Water Conveyance, Treatment, and Distribution System

RELIABILITY: GROUNDWATER BASINS

During any dry period when local and imported supplies do not meet the county's water needs, stored water is used to make up the difference. Most of the county's available storage is in the groundwater subbasins. A major concern for the District has been contamination of groundwater supplies. (This is discussed in greater detail in Chapter 4.) If any or all of the county's three subbasins suffer severe contamination by a chemical spill or nitrogen applications, their use as a source of drinking water could be either restricted or prohibited.

GROUNDWATER BASIN

The Santa Clara Valley Groundwater Basin provides about half of the county's demand for potable water. For analysis purposes, the basin is divided into three interconnected groundwater subbasins. Significant characteristics of these subbasins are described below.

Santa Clara Valley Groundwater Subbasin

The Santa Clara Valley Subbasin extends from Coyote Narrows at Metcalf Road to the county's northern boundary. It is bounded on the west by the Santa Cruz mountains and on the east by the Diablo Range; these two ranges converge at the Coyote Narrows to form the southern limit of the subbasin. The subbasin is 22 miles long and 15 miles wide, with a surface area of 225 square miles. A confined zone within the northern areas of the subbasin is overlaid with a thick clay layer. The southern area is the unconfined zone, or forebay, where the clay layer does not extend.

The DWR has estimated the storage volume of this subbasin to be 1,770,000 af (Bulletin No. 7). This estimate does not take into account operational constraints such as land subsidence, which will recur here if groundwater elevations drop below certain thresholds for an extended period of time; nor does it consider the need to keep groundwater levels from interfering with the District's recharge operations or causing basement flooding. The volume of groundwater storage between the subsidence threshold and the maximum that is suitable for District operations is called the "operational storage capacity." Currently, the estimated operational storage capacity of the Santa Clara Valley Subbasin is 250,000 af. As further studies using the District's groundwater model are made, the operational storage capacity of this subbasin will be refined.

Llagas Groundwater Subbasin

The Llagas Subbasin extends from Cochran Road south to the county's southern boundary. It is connected to the Bolsa Subbasin of the Hollister Basin and bounded on the south by the Pajaro River (the Santa Clara-San Benito County line). The Llagas Subbasin is approximately 15 miles long, 3 miles wide along its northern boundary, and 6 miles wide along the Pajaro River. The subbasin surface area is approximately 74 square miles. A thick clay layer which extends north from the Pajaro River divides this subbasin into confined and forebay zones. In DWR Bulletin No. 7, the storage volume was estimated to be 475,000 af. District staff has estimated the operational storage capacity of the subbasin at 150,000 af.

Coyote Groundwater Subbasin

The Coyote Subbasin extends from Metcalf Road south to Cochran Road, and drains into both the Llagas and the Santa Clara Valley subbasins. This subbasin is approximately 7 miles long and 2 miles wide and has a surface area of approximately 15 square miles. The entire subbasin is unconfined and has no thick clay layers. From DWR Bulletin No. 7, the subbasin storage capacity was estimated to be 76,000 af. District staff has used an operational storage volume of 55,000 af.

RECHARGE FACILITIES

The District owns and operates more than 30 recharge facilities in six major recharge systems. These facilities percolate both local and imported water into the groundwater aquifer. The total recharge capacity of these systems is 157,200 af/year. Significant features of these artificial recharge systems appear in Table 3.2.

TABLE 3.2
Artificial Recharge Systems

Recharge System	Existing Recharge Rate (acre-feet/year)	Average Summer Rate (acre-feet/day)	Average Winter Rate (acre-feet/day)
Westside	17,000	55	39
Los Gatos	42,000	134	117
Guadalupe	26,800	98	63
Penitencia	6,500	20	16
Coyote	43,000	157	87
South	21,900	60	60

RELIABILITY:
RECHARGE FACILITIES

The year 1994 will be the last year that the District will have a blanket permit from Fish & Game and the Corps of Engineers to construct 54 gravel dams within streambeds to intensify groundwater recharge and to divert stream water to off-stream recharge ponds. Regulatory agencies are now placing a higher value on stream habitats and are no longer issuing blanket permits for gravel dam construction. District staff is working on obtaining a 5-year permit for the construction of 51 gravel dams; permit restrictions are not yet known. Such restrictions could have a major impact upon the District's ability to conduct effective recharge and basin management, and need to be investigated.

Field explorations conducted in the late 1970s identified two major groundwater recharge areas which the District could develop to accommodate the South County's future water needs. In 1993, extensive field work was completed to determine recharge rates for the ponds designed for these sites. During this investigation, thin lenses of clay layers were discovered. As a result of these clay lenses, the estimated recharge capacity was reduced to 9,125 af/year from the original estimate of 32,000 af/year. This drastic reduction in recharge capacity could create obstacles to meeting future water demand in the South County, and must be reinvestigated.

RELIABILITY:
CONVEYANCE PIPELINES

The seismic vulnerability of the District's raw water conveyance facilities was tested during the 1989 Loma Prieta earthquake. This quake was "major" (magnitude 7.1) and the epicenter was relatively close to Santa Clara County. Air release valves acted as the weak link—some were driven open and stuck in this position, and some failed. No pipeline failure occurred; however, the Santa Clara conduit experienced differential settling and repairs to one of the conduit's two pipelines was necessary. The "design earthquake" magnitude on the San Andreas fault is greater than 8.0.

RELIABILITY:
TREATMENT PLANTS

During the Loma Prieta earthquake, the Penitencia and Santa Teresa treatment plants sustained only minor damage. However, the Rinconada plant suffered severe damage—wave forces did major damage to the three clarifiers that were in operation at the time. Because one of the clarifiers was down for cleaning, and maintenance was able to bring it back on line in 36 hours, the plant was able to produce some treated water in the months after the earthquake. The equipment manufacturer rerouted needed spare parts from another client and the District was able to get back on line in 5 months, at a cost of $1 million. The inlet to the Rinconada Reservoir was also damaged during the earthquake.

The Penitencia plant was built on the site of an old landslide which has moved over 10 feet. It is uncertain what portion of this movement is attributable to the initial movement and what has resulted from long-term creep. In a recent investigation, it was

RAW WATER CONVEYANCE SYSTEM

The District uses several local pipelines to transport imported raw water and locally conserved water to various locations for treatment and distribution, or for groundwater recharge. The raw water conveyance system first meets the demands of the WTPs and then delivers the remaining water to recharge systems. This conveyance system consist of the Central Pipeline, the Rinconada Force Main, the Almaden Valley Pipeline, the Calero Pipeline, and the Cross Valley Pipeline. Another facility, the Stevens Creek Pipeline, taps off of the Rinconada Force Main and conveys raw water to recharge facilities on the county's west side.

The District owns and operates the Vasona Pumping Plant, with a total capacity of 1,200 horsepower, which is located at the juncture of the Central Pipeline, the Rinconada Force Main, and the Almaden Valley Pipeline. The Vasona Pumping Plant can pressurize any of these three pipes. The District also operates two pumping plants on the San Felipe Project: the Pacheco Pumping Plant and the Coyote Pumping Plant, with a combined horsepower of 36,000.

SURFACE WATER TREATMENT

Water from both the SWP and CVP is sent to the District's WTPs, where it is purified before being delivered to water retailers, who in turn deliver the water to homes and businesses in the county. The District's three WTPs are described below.

Rinconada Water Treatment Plant

The Rinconada WTP is a conventional treatment facility with sedimentation, filtration, and disinfection. The plant was constructed at a cost of $9 million and can sustain a maximum flow rate of 75 million gallons per day (mgd) with an adequate margin of safety approved by the Department of Health Services to meet state drinking water standards. Of the 75 mgd capacity, 3 mgd are for internal use (backwash water, chemical feed water, etc.) and 72 mgd are wholesaled to water retailers.

Penitencia Water Treatment Plant

The Penitencia WTP is a conventional treatment facility with coagulation, flocculation, sedimentation, filtration, and disinfection. The plant was constructed at a cost of $5 million and can sustain a maximum flow rate of 42 mgd with an adequate safety margin. Of its capacity, 2 mgd are for internal use and 40 mgd are wholesaled to water retailers.

estimated that the Hayward fault could cause between 1 and 6 feet of slippage in parts of the slide. The reliability of this plant needs further investigation, and the District must decide whether or not to decommission it. The reliability of all three of the District's treatment plants to serve the county's needs after an earthquake should be analyzed.

RELIABILITY:
IMPORTED SUPPLIES

All of the SWP and CVP water imported to the District flows through one major artery: the Sacramento-San Joaquin Delta. If an earthquake were to cause the collapse of levees in the Delta, brackish water from the San Francisco Bay would rush in. This would make the water that flows through the Delta too salty for use and could severely restrict water imports to the county. The likelihood and impacts of this potential outage are not well understood and need to be investigated further.

In addition, the three imported water conveyance pipelines into the county all cross major fault lines and are vulnerable to large fault movement. (Some modifications have been made to the federal Santa Clara Pipeline to accommodate fault creep.) The potential for earthquake-related outages and their impact on the District's water supply system need further investigation.

Santa Teresa Water Treatment Plant

The Santa Teresa WTP is a conventional treatment facility with coagulation, flocculation, sedimentation, filtration, and disinfection. The plant can sustain a maximum flow rate of 100 mgd with an adequate margin of safety. This level of production is not anticipated until well into the next century. This facility was built at a cost of $50 million.

IMPORTED WATER

Imported water travels into Santa Clara County through three main pipelines: The SBA, which carries water from the SWP, and the Santa Clara Conduit and Pacheco Conduit, which bring water from the CVP. The City and County of San Francisco conveys Hetch Hetchy water through its own facilities.

WATER DISTRIBUTION SYSTEM

Figure 3.2 schematically shows how all water distribution system components are utilized to serve the water demands of Santa Clara County.

FIGURE 3.2
System Distribution

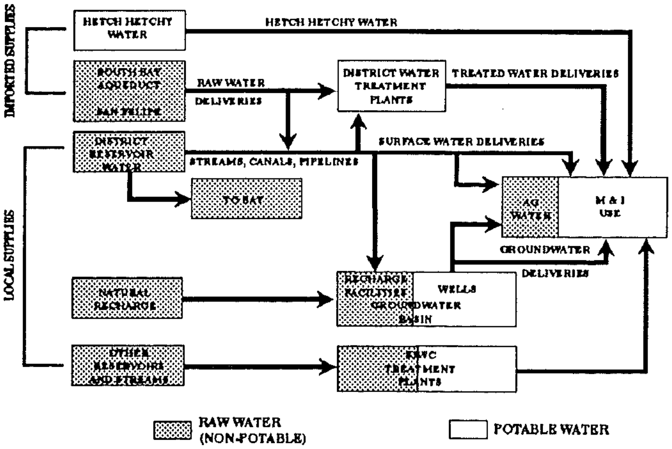


FIGURE 3.2

RECLAIMED WATER

In 1977, the Palo Alto Reclamation Facility constructed by the District began operation and was the first reclaimed water developed within the county. This facility was designed to provide a seawater barrier to prevent bay water from entering into the upper aquifer and also to produce nonpotable reclaimed water for irrigation of two nearby golf courses. Nonpotable water is still produced from the plant but is now under the authority of the Palo Alto Regional Water Quality Control Plant. Shortly after the Palo Alto facility was started, the District in a joint venture started the Gilroy Reclamation Facility which is still operating today. Since these two early ventures by the District, the Cities of Santa Clara and Sunnyvale have also begun to reclaim water with markets developed within each city. Approximately 1,000 af of nonpotable reclaimed water is developed within the county annually.

SUMMARY

Santa Clara County's water supply comes from local surface water yield, the local groundwater basin, and surface water imported through the SWP, CVP, and Hetch Hetchy project.

The District operates a system of reservoirs, groundwater recharge facilities, conveyance pipelines, pumping plants, and water treatment plants for water storage, distribution, and treatment. The components of the District's water supply system are vulnerable in varying degrees to earthquakes, flooding, contamination, and regulatory restrictions. These risks affect the District's operational reliability and must be taken into account in the evaluation and selection of options for supplementing the District's water supply.

Chapter ④

Drinking Water Quality Issues

Chapter 4
DRINKING WATER QUALITY ISSUES

A major challenge for the District is to meet the water quality regulations imposed by the SDWA Amendments of 1986. This chapter provides a brief overview of the District's treatment system. It describes the drinking water quality regulations facing the District, the challenges they pose, and the physical/operational modifications or additions needed to meet these challenges.

INTRODUCTION

The new water quality regulations that affect the District are the result of the Safe Drinking Water Act (SDWA) Amendments of 1986. The regulation with the greatest potential impact is the D/DBP Rule, which may force the District to implement an alternative disinfectant instead of the free chlorine that is currently used. If modifications to current disinfection practices are required, they could have significant cost impacts. Initial estimates for treatment plant modifications to incorporate one alternative disinfection method, ozonation, are as high as $150 million. In addition to the new D/DBP regulation, a wide variety of other new regulations are also being adopted by EPA to meet the requirements of the SDWA.

WATER TREATMENT AT THE DISTRICT

The District began treating water in 1967 when the Rinconada WTP was placed in service. This was followed by Penitencia WTP in 1974 and Santa Teresa WTP in 1989. All three treatment plants use a conventional process of coagulation, flocculation, sedimentation, and dual media filtration. Disinfection is accomplished with the use of free chlorine. These are standard processes used throughout the country to comply with water quality regulations and produce a high-quality drinking water.

The use of chlorine has been responsible for eliminating a wide variety of communicable diseases such as typhoid fever and cholera. Chlorine is a strong, reliable, and inexpensive oxidant. However, the use of chlorine as a primary disinfectant has received increasing criticism over the past 10 to 15 years due to its formation of by-products at low concentrations, primarily Trihalomethanes (THMs), which are possible human carcinogens.

The District's WTPs have always operated reliably in producing high-quality drinking water. The greatest challenge has been complying with the Total Trihalomethane (TTHM) standard because of poor source water quality, primarily in times of drought. The District has been successful in this effort with the exception of one incident exceeding the Maximum Contaminant Level (MCL) at Rinconada in 1982. The District's success has been primarily due to a change in the distribution system residual from free chlorine to chloramine, which does not react with the organics in the water to form THMs.

CALIFORNIA'S WATER QUALITY REGULATIONS
Drinking water quality regulations are typically developed and promulgated by the federal EPA which has ultimate authority and responsibility to enforce them. EPA does not have the resources to enforce regulations throughout the nation and typically delegates this authority to the states through a process called primacy. California is a primacy state and regulates the SDWA for EPA. California adopts its own drinking water quality regulations but must make them at least as strict as federal regulations. California generally develops stricter regulations.

The California Safe Drinking Water Act (CSDWA) was enacted with the signing into law of Assembly Bill 21, also referred to as the Sher Bill. According to the language of the bill, the CSDWA is intended to improve upon the minimum requirements of the Federal SDWA by establishing a program within Department of Health Services (DHS) that is more protective of public health. The result is a dual set of published drinking water standards in California. The Sher Bill requires DHS to adopt Recommended Public Health Levels (RPHLs) for all contaminants in drinking water. The RPHLs are to be at least as stringent as MCLs promulgated under the Federal SDWA. The establishment of RPHLs is to be based solely on health factors without consideration to the cost impact or technical feasibility. RPHLs for acutely toxic contaminants are to be set at a level of no known adverse health effects plus a margin of safety. Carcinogenic or substances causing chronic disease will have RPHLs set at a level which DHS determines poses no significant risk to health.

SAFE DRINKING WATER ACT AMENDMENTS OF 1986

The SDWA Amendments of 1986 required the EPA to develop standards for a wide range of constituents including volatile organic chemicals, synthetic organic chemicals, inorganic chemicals, microbial (including mandatory filtration for surface waters), corrosion by-products (lead and copper), radionuclides, disinfectants, and DPB. To meet the mandates in the SDWA, EPA has developed regulations in a series of rules. The single rule with the potential for the greatest impact on the District is the D/DBP Rule. Three other rules have a lesser but still significant impact on the District; the SWTR, Lead and Copper Rule, and Total Coliform Rule.

Surface Water Treatment Rule

The SWTR promulgated on June 29, 1989, regulates acute health effects caused by *Giardia Lamblia,* viruses, *Legionella*, and heterotrophic bacteria. The rule requires filtration or other treatment of surface water supplies to protect against viral, parasitic and bacterial contamination and has mandated disinfection of all public water supplies.

The SWTR requires the installation and proper operation of water treatment processes to reliably achieve at least 99.9 percent (3 log) removal/inactivation of *Giardia Lamblia* and 99.99 percent (4 log) removal/inactivation of enteric viruses for systems using surface water sources. The District uses conventional filtration processes that have been credited with achieving at least 99.7 percent (2.5 log) of the required 3 log removal of *Giardia* cysts and 99 percent (2 log) of the required 4 log removal of viruses when operated properly. The remainder of the required removal/inactivation is achieved through disinfection.

Disinfection must be sufficient to ensure that the total treatment process provides inactivation of *Giardia* cysts and viruses, in conjunction with the removals obtained through filtration, to meet the removal/inactivation requirement. This must be demonstrated by the system each day it delivers water to consumers. Based on the results of tracer studies conducted by the District, all of the treatment plants can meet the required disinfection to inactivate 0.5 log of *Giardia* and 2 log of viruses using current operations. In fact, District treatment plants often achieve two to three times the required disinfection. This additional disinfection does increase the DBPs and makes it more difficult to comply with the D/DBP Rule.

An operational aspect of the SWTR affecting the District is that filtration rates for dual media filters are not to exceed 6 gallons per minute/square foot (gpm/sq. ft.). This filtration rate can be exceeded at Penitencia and Santa Teresa at design flow capacity, when one filter is taken out of service during backwash. In order for the District to operate Penitencia and Santa Teresa at filter loading rates in excess of 6 gpm/sq. ft., the District must conduct higher filtration rate demonstration studies. The District is currently conducting such a study at Penitencia which should be completed in the summer of 1994. Preliminary data indicates that the filters can be operated at higher filtration rates without water quality degradation.

Another requirement of the SWTR is that all surface water suppliers must conduct a sanitary survey of their watershed(s) at least every 5 years with the first survey to be completed by January 1, 1996. Due to both the increasing number of contaminants regulated under the SDWA, and the realization that some pathogens are extremely difficulty to treat, drinking water enforcement is now encouraging water agencies to protect their drinking water at the source. As part of this new direction in enforcement, drinking water regulatory agencies are more strictly interpreting source water protection elements of the current SDWA. The District is now developing a program for source water protection in its Comprehensive Reservoir Watershed Management Project (CRWMP).

The District owns and operates ten reservoirs within the county. All ten reservoirs are used for groundwater recharge with four also capable of supplying water to a District treatment plant. The District only owns about 4 percent of the land within these reservoir watersheds. Therefore, a variety of land uses and activities occur within these watersheds, beyond the District's control, that can degrade reservoir water quality.

In the past, the District has provided minimal or no input on activities and development proposed in its reservoir watersheds, and has left management of land use and land activities to private property owners and the County of Santa Clara. Additionally, the District's limited review of development proposals only occurs on a case-by-case basis, which prevents the District from considering the many cumulative reservoir water quality impacts that occur due to the gradual development of its reservoir watersheds.

In the CRWMP, the District will perform this cumulative reservoir watershed evaluation. The CRWMP includes an examination of nine of the District's reservoir watersheds, will cover approximately 210,000 acres, and should be completed by December 1996. The CRWMP will evaluate the impacts that various land uses and activities have on reservoir water quality, and will develop a program to modify these land uses and activities to minimize or eliminate water quality impacts and maintain other beneficial uses.

Lead and Copper Rule

In June 1991, the EPA published its Lead and Copper Rule, which established Maximum Contaminant Level Goals (MCLGs) for both lead and copper and treatment techniques for optimal corrosion control, source water treatment, public education, and lead service line replacement. The rule also specified monitoring requirements and compliance schedules based on system size.

The rule sets action levels for both lead (0.015 milligram per liter [mg/l]) and copper (1.3 mg/l), and some requirements only apply if monitoring shows that action levels are exceeded. One of the most difficult and controversial aspects of the rule are the monitoring requirements that require tap sampling in consumer households after water has been standing for more than 8 hours. Sampling must also take place in "worst case" buildings that have either lead service connections, lead pipes, or copper tubing with lead solder installed after 1982. Two 6-month tap samplings for lead and copper have been completed before the required date of January 1, 1993.

The Lead and Copper Rule's greatest effect on the District is the requirement for corrosion control studies. The District is not required to conduct tap sampling since it is not a retailer. But to comply with the rule, the District initiated a joint corrosion control investigation with 12 retailers. The District identified seven water sources for the county (although not all supplied by the District), including blends. Pipe loop testing to evaluate each water source began in April 1993. The project should be completed by June 1994.

Total Coliform Rule

The Total Coliform Rule was adopted by the state in July 1992 to regulate total coliform as a contaminant. The Coliform Rule set an MCLG of zero for total coliform and an MCL based on the presence-absence of total coliform, rather than an estimate of coliform density as it was regulated in the past.

The new rule is more stringent than previous coliform monitoring. If more than 5 percent of the monthly samples test positive for total coliform, the system is out of compliance. If a routine total coliform-positive sample tests positive for fecal coliform or E. coli and the repeat sample is positive for total coliform, the system is in violation of the MCL. This situation represents an acute MCL violation that would trigger public notification. The District has been collecting and analyzing water samples according to the new rule and has always complied.

DISINFECTANT/DISINFECTION BY-PRODUCT IMPACTS
The D/DBP Rule will have a major effect on the District's water utility. This impact is directly linked to the quality of Delta water and the difficulty in treating it. Unless ways can be found to improve the quality of the water that is imported to the District from the Delta, the District will likely be faced with major modifications of its treatment plants at a substantial cost. The difficulty and costs associated with treating Delta water need to be carefully considered.

DISINFECTANT/DISINFECTION BY-PRODUCT RULE

Regulation/Negotiation Process

The 1986 amendments to the SDWA also required EPA to promulgate revised regulations governing the use of disinfectants and their by-products. Because of the complexity of the issues, and the inherent conflict in minimizing DBPs while ensuring adequate bacteriological treatment, a regulation negotiation (Reg-Neg) process was initiated to develop these regulations. The EPA, water suppliers, environmental groups, consumer advocates, and other interested parties entered into the Reg-Neg process.

The Reg-Neg process resulted in the development of three separate rules to address disinfectants and their by-products. They are the D/DBP Rule, the Enhanced Surface Water Treatment Rule which may require more disinfectant, and the Information Collection Rule (ICR) to support the other two rules. These three rules may still undergo changes prior to being finalized.

Disinfectants/Disinfection By-Products Rule

Because little is known about the formation of most DBPs and treatment effectiveness, the D/DBP Rule will be developed in two stages. Stage 1 is scheduled to be promulgated in December 1996 with compliance in June 1998. It will set an MCL for TTHMs at 80 parts per billion (ug/l) and an MCL for the five haloacetic acids (HAAs) at 60 ug/l. MCLs will also be set for bromate at 0.01 mg/l and chlorite at 1.0 mg/l.

Stage 1 will also require plants with raw water total organic carbon (TOC) levels above 2 mg/l, which the District's source water is, to practice an enhanced coagulation prior to primary disinfection with chlorine or chloramine. The intent is to minimize the formation of halogenated organic compounds known or suspected to present health risks. To comply with the requirements, a utility must achieve a minimum TOC removal, maintain optimal pH during coagulation, or reach the point of diminishing returns for increasing coagulant doses. No disinfection credit will be given prior to meeting the enhanced coagulation requirement.

The District is conducting pilot studies and plant-scale studies to determine options for meeting the enhanced coagulation criteria. Chlorination will be delayed at all the plants. This may allow taste- and odor-causing compounds to get through the plant because the prechlorination step is eliminated, but would meet the disinfection requirements of the SWTR. But once chlorination is delayed, the District should meet the Stage 1 TTHM and the HAA MCLs. The District will also be conducting a series of plant-scale tests to confirm pilot results to meet the Stage 1 D/DBP Rule requirements and examine long-term operational issues. The plant-scale tests will include investigating alternative coagulants and improving taste and odor control mechanisms.

Stage 2 of the D/DBP Rule will be renegotiated following collection of additional information under the ICR. Currently, Stage 2 will require TTHM and HAA MCLs be 40 and 30 ug/l, respectively.

The District has embarked on an extensive investigation into alternative disinfectants in anticipation of complying with Stage 2 regulations. The scope of this investigation includes pilot-scale studies, bench-scale testing, and full-scale plant feasibility testing. The study should identify the treatment processes that will meet the District's water quality goals and have the flexibility to meet future regulations, and also provide the design criteria and cost estimates for modifications to the treatment plants.

The processes being investigated are ozonation, advanced oxidation, granular activated carbon (GAC) adsorption, and biological filtration. Enhanced coagulation for DBP precursor removal and pH adjustment will also be investigated. The cost for the pilot investigation and the predesign is approximately $4,500,000. Costs for retrofitting the three treatment plants with ozone could be as high as $150 million.

Concurrent with the pilot studies, preliminary design activities are being conducted. These include engineering, geologic, and geotechnical studies for each plant to assess the feasibility of adding structures as part of the planned modifications, with emphasis on the Penitencia site.

Information Collection Rule

The ICR has three major components: microbial monitoring, DBP monitoring, and bench-scale testing, pilot-scale testing, or both. By this rule, the District must monitor for *Giardia*, *Cryptosporidium*, viruses, fecal coliform or E. coli, and total coliform. The District must also monitor for DBPs, TOC, total organic halogen, and water quality parameters at plant influents, within the treatment process, the entry point to the distribution system, and within the distribution system.

The District must conduct precursor removal studies at each plant unless the source waters are not significantly different. These studies must include at least two membranes and GAC testing with at least two empty bed contact times.

DELTA WATER QUALITY

The significant impacts of the Stage 2 D/DBP Rule on the District are largely attributable to the quality of the water imported from the Delta for water treatment. A 1991 report to the California Legislature on Delta Water Quality states that "The quality of drinking water from the Delta does pose . . . a potentially serious problem to the utilities charged with treating the water to meet anticipated federal standards." It goes on to point out that given the SWTR and the anticipated stricter standards for DBPs, " . . . It is clear that water utilities charged with protecting public health through treating drinking water from the Delta will face serious problems in meeting anticipated state and federal standards." District experience confirms that it will be very difficult to meet future D/DBP regulations while simultaneously enhancing the treatment process to provide greater microbiological inactivation.

Delta water is highly variable on both a daily and seasonal basis. Fluctuations in turbidity, temperature, chlorides, bromides, TOC, and other parameters necessitate flexible and robust treatment processes that can accommodate a highly variable source water and still produce a consistently high-quality treated water. These water quality parameters have a major influence on the amount of disinfection that is required and on the types and amounts of DBPs produced. While the quality of Delta water imported through the San Felipe Division is much less variable due to the buffering effects of San Luis Reservoir, it can often be of worse overall quality than water imported through the SBA. This is especially true in low water years when San Luis Reservoir is filled in the fall with Delta water that suffers from seawater intrusion. Additionally, when water levels are low in San Luis Reservoir, the risk of algae-induced tastes and odors increases.

Bromides in the Delta

A 1989 report prepared for the Bay-Delta Hearings points out that seawater intrusion into the Delta is the major source of chlorides and bromides present in the exported water. Chlorides and bromides present in Delta water along with organic precursors form THMs and other DBPs when treated with chlorine or ozone. Bromide is especially problematic for a few reasons. First, since it is likely that many DBPs will continue to be regulated by weight, brominated DBPs are a serious concern since the molecular weight of bromine is about twice that of chlorine. This means that increased seawater intrusion leads to increased concentrations of bromide and increased concentrations of brominated DBPs after treatment. This in turn makes it very difficult to meet standards that are weight based. Secondly, when treated with ozone, bromide can form bromate, a DBP likely to be regulated under the D/DBP Rule at very low levels. With regard to the D/DBP Rule, the issue of bromides present in Delta water is perhaps the major concern of California water utilities treating Delta water for drinking.

Total Organic Carbon Loading in the Delta

Another factor which dramatically influences the amount and types of DBPs formed is the amount of TOC present. Sources of TOC in the Delta include organics from the tributary rivers, seawater intrusion, decaying organic matter in the channels and bays, and agricultural return drainage from Delta Islands. The higher the level of TOC the higher the level of DBPs following disinfection. Significantly, preliminary findings of a 1990 report prepared by the DWR showed that organic matter from Delta Island drainage has up to ten times the tendency to form DBPs as does organic material from upstream river samples, due to its larger molecular weight and different composition. The source of this TOC loading is primarily the peaty soils which make up many of the Delta islands and is not solely the result of the concentrating effects of evapotranspiration on applied irrigation. This makes Delta Island drainage a significant contributor to DBP formation in Delta water.

GROUNDWATER REGULATIONS

Groundwater Disinfection Rule

EPA is currently developing the GWDR which may require disinfection of all source water from wells. The rule would not directly impact District operations, but would certainly impact the cost of producing groundwater by the water retailers.

The draft GWDR would require disinfection of each well in the system, which would require a 99.99 percent level of inactivation with a residual disinfectant concentration of at least 0.2 mg/l. Depending on the final rule, there may be adverse impacts on disinfectant by-product formation within the distribution system.

There are exceptions to the draft rule that would allow individual wells to be excluded from the rule's disinfection requirements. The criteria will consider the estimated travel time from the nearest source of contamination to the well. Based on the travel time adopted in the final rule, retailers may obtain exclusions for some or all wells.

A final GWDR is scheduled to be adopted in August 1997. The implementation schedule may require disinfection systems to be operating by December of 1999.

Radionuclides Rule

The SDWA Amendments of 1986 mandated that the EPA establish a drinking water standard for radon by June 1989. In July 1991, EPA proposed a standard that would require water purveyors to remove radon from drinking water if a level of more than 300 picoCuries/liter (pCi/l) is detected in a water supply well. Recent legislation has prohibited EPA from promulgating a standard until September of 1994 to allow more time to assess the need for and implementation cost of such a standard.

Radon gas is found in groundwater supplies throughout the United States. It is released from water supplies during household water use and contributes a very small proportion to the indoor household air levels of radon. Radon gas is considered a health risk and has been linked to lung cancer. However, whether the small proportion of radon gas contributed by the water supply to indoor air levels is significant in terms of increased health risk is currently being debated.

The proposed MCL of 300 pCi/l for radon would raise significant compliance issues for water retailers in Santa Clara County. Various studies show that the radon levels in most groundwater wells in Santa Clara County may exceed the proposed 300 pCi/l level. In 1988, 12 public supply wells were surveyed for radon in Santa Clara County and radon levels in these wells were all above 300 pCi/l with a maximum of 580 pCi/l. In 1991, the District tested five wells and found four of the wells had radon levels above the proposed MCL of 300 pCi/l.

The treatment processes for radon levels exceeding the proposed MCL would be aeration and/or carbon adsorption. The cost of this treatment would have a significant impact on the cost of groundwater production.

Regulations Requiring Groundwater Cleanup and Protection

The District conducts extensive programs to protect and cleanup groundwater contamination to ensure the continued full utilization of the basin for storage and distribution of water. The California Water Code requires the maintenance of water quality for all beneficial uses consistent with the best interests of the people of the state.

The California Regional Water Quality Control Boards (CRWQCB), San Francisco Bay and Central Coast Regions, have more than 300 cases of groundwater and soil contamination cleanup cases caused by nonfuel related chemical spills or leaks in Santa Clara County. The District supplements the CRWQCB's programs by overseeing the cleanup of more than 1,600 fuel contaminated sites within the county. The cities and the county oversee the removal of leaking underground fuel storage tanks and report any leakage to the District. The District's program to oversee the cleanup of remaining soil and groundwater contamination is funded primarily by the State Water Resources Control Board (SWRCB) Local Oversight Program with supplemental funds provided by the District. More than 300 of these fuel leak cases have been completed.

The 1986 SDWA Amendments outlined a program for wellhead protection to encourage agencies to develop programs and policies that would protect wells from contamination. The District has conducted a pilot program in the city of Campbell using EPA grant funds. A countywide program to protect the most vulnerable recharge areas of the basin from contamination is now being developed to maintain the high quality of the underlying groundwater.

SUMMARY

The SDWA Amendments of 1986 have resulted in several new water quality regulations. These regulations include the D/DBP Rule, the SWTR, the Lead and Copper Rule, and the Total Coliform Rule.

The D/DBP Rule will have far-ranging impacts on the District's water utility. These impacts are directly linked to the poor quality of the Delta water that is delivered to the District for treatment: poor-quality water leads to higher levels of DBPs. The D/DBP Rule will probably require major modifications of District treatment plants at a substantial cost.

Other rules are currently being considered which would not directly affect District operations but would raise significant compliance issues for water retailers in the county. These include the EPA's proposed GWDR, which may require disinfection of all source water from wells, and the EPA's proposed Radionuclides Rule, which would set maximum levels for radon in drinking water wells.

Chapter 5

Forecasting Future Water Needs

Chapter 5
FORECASTING FUTURE WATER NEEDS

This chapter describes the District's forecast for Santa Clara County's water needs to the year 2020, and explains how the District arrived at these projections. It also describes how this forecast differs from the water use projections that were developed in the District's 1975 Master Plan.

INTRODUCTION

Meeting the county's changing water needs requires a comprehensive water demand projection together with supply analysis. In 1975, the District developed its first comprehensive water supply plan: the 1975 Master Plan. This plan assessed the county's water needs to the year 2020. It identified the District's need for supplemental water and guided development of the District's water supply, distribution, and treatment facilities for nearly two decades.

If the trends used as the planning assumptions for the 1975 Master Plan had evolved as anticipated, the District's water supply and facilities would be adequate to meet the county's water demands for the foreseeable future. However, recent demographic, economic, and water use trends in Santa Clara County have diverged from those anticipated in the 1975 plan. In 1993, the District analyzed the county's future water needs from a vantage point based on a comprehensive analysis of historical water use trends and the most recent demographic information available.

THE COUNTY'S CHANGING WATER NEEDS

Santa Clara County ranks fourth in the state in terms of population and jobs. Its industries provide more than 6 percent of the state's employment with a gross regional product of more than $40 billion annually. M&I water demand, which includes residential, commercial, and industrial water use, has grown as a result of urbanization. Conversely, agricultural water demand has declined as irrigated agricultural land has been converted to other uses.

The District has been recording water use in the North County since 1964, but its records for South County water usage are relatively short, beginning in July 1987. Figure 5.1 shows the recorded M&I water use for North and South Counties. This water use figure has varied from a low of about 175,000 af in 1965 to a high of about 330,000 af in 1988 for the North County. The South County M&I usage is approximately 20,000 af. Figure 5.1 illustrates the impacts of the two water supply shortage periods, 1976 to 1977 and 1987 to 1992, when the county responded to drought by using less water. The recorded water use from 1983 to present includes varying amounts of pumping for groundwater cleanup efforts, as high as 17,000 af for 1984.

WHAT INFLUENCES WATER DEMAND?

The most apparent influences on water demand are consumptive water use patterns and growth. As the population and industries grow in a region, water use increases.

Changes in the way people use water are often gradual and hard to quantify. For example, changes in the efficiency or number of water-using devices commonly found in the home, in the popularity of backyard swimming pools, or in the acceptance of low-water-use alternatives to the traditional (but water-hungry) lawn can significantly alter water demand trends. Groundwater cleanup efforts can be very water-intensive, increasing water use significantly during their duration. Weather conditions such as temperature and rainfall have a pronounced effect on outdoor water use.

Figure 5.1 shows North County M&I water use over a 25-year period. The most dramatic variations in Figure 5.1 are the drops in use during the droughts of 1976 to 1977 and 1987 to 1992. Due to supply limitations, either voluntary or mandatory use reduction measures were enacted in these years. After a drought ends, as people replace lost landscape and return to previous water use habits, water demand returns to previous levels. The years after the 1977 drought show this effect. The rebound from the most recent drought is further complicated by the current economic recession in the region. As industries cut back on production due to the recession, their water use decreased as well. To some degree, the timing of water demand rebound from this most recent drought is tied to the economic recovery of the county.

FIGURE 5.1
County Municipal and Industrial Water Use, 1967 to 1992

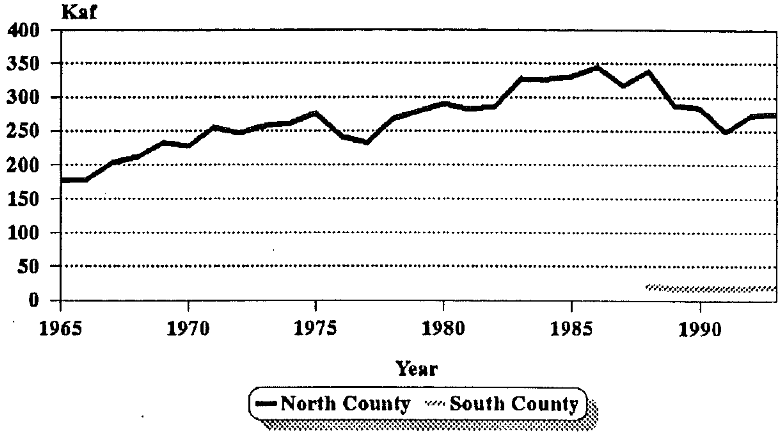


Figure 5.1

If the water use patterns of the 1980s had continued, the county's current water needs would have been around 425,000 af. As a result of water-saving efforts brought on by the drought of 1987 to 1992, current water use is about 325,000 af compared to a predrought high of 393,000 af in 1987.

WATER DEMAND PROJECTIONS

How Much Water Will We Need?

The District's water demand forecast described in this chapter comprises the base projection; the reductions in demand that are expected from District's demand-side management programs are described.

The base water demand projection for the county in the year 2020 is 515,000 af. This base represents the demand expected under average weather conditions if no conservation efforts are taken beyond the savings resulting from plumbing code changes mandating the use of low-water-use plumbing fixtures. Projections for various years and water uses are summarized in Table 5.1.

TABLE 5.1
Average Weather Water Demand Projections

Area		Projected Water Use (in Kaf)			
		1990	2000	2010	2020
Santa Clara Subbasin	West—M&I	182	194	202	211
	Central—M&I	96	108	115	122
	East—M&I	54	67	77	83
	Agricultural	6	6	4	3
	Total	338	375	398	419
Coyote Subbasin	M&I	1	6	8	11
	Agricultural	10	8	6	4
	Total	11	14	14	15
Llagas Subbasin	M&I	16	22	33	43
	Agricultural	51	47	42	38
	Total	67	69	75	81

Outdoor water use is influenced by weather; landscaping requires more water when the weather is hot and dry than when it is cool. The projected demand for year 2020 ranges from 495,000 to 537,000 af depending on the weather conditions assumed. Projections for different weather conditions are shown in Figure 5.2.

FIGURE 5.2
Water Demand Projections
(Different Weather Conditions)

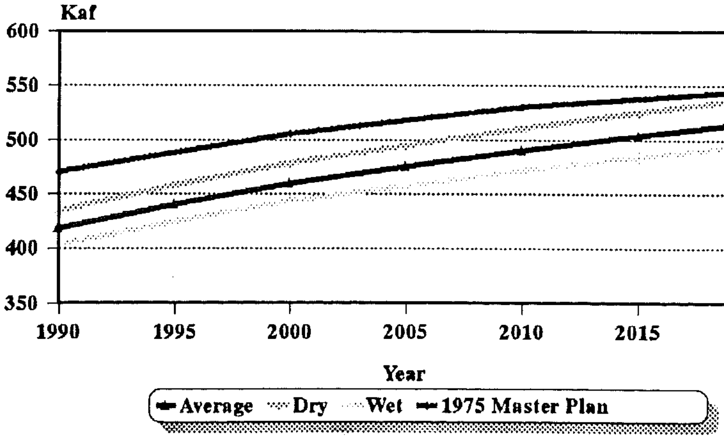


Figure 5.2

Projection Methods

Water demands were projected for 23 subareas, called water service areas (WSAs), which represent all of the water retailers' areas within Santa Clara County. The demands were projected in four categories: (1) residential, subdivided into single-family and multifamily subcategories, (2) commercial/ industrial, (3) unaccounted, and (4) agricultural.

The projected residential and commercial/industrial water demands depend on the projected number of households and employees, respectively, in each WSA. The major source of demographic projections used was the Association of Bay Area Governments' (ABAG) *Projections 1990*. ABAG projections were obtained by 5-year increments to the year 2005. The District then extended these projections to 2020 with concurrence of the local city planning agencies. The demographic projections used in the water demand analysis reflect the comments received by the local agencies.

Based on this information, jobs in the county are projected to increase by approximately 1.8 percent per year from the present 870,000 to 1,300,000 jobs by the year 2020. The number of households is expected to increase by approximately 1 percent per year from the present 520,000 to 680,000 households by the year 2020.

- *Residential*—Residential water demand was forecasted using methods taken from the U.S. Army Corps of Engineers (Corps) water demand forecasting model, IWR-MAIN. The model was calibrated for Santa Clara County using local water use records. For single-family households, the water use ranged from 292 to 453 gallons per household per day. Multifamily water use was lower, ranging from 254 to 349 gallons per household per day.

- *Commercial/Industrial*—A per-employee water use coefficient of 129 gallons per day (gpd) was used for the commercial/industrial water demand. This coefficient was developed from local water use data. The projected commercial/industrial water demand was computed based on this coefficient and the projected number of employees in each WSA.

- *Unaccounted*—Municipal water use includes water supplied that is otherwise unaccounted for (either losses in the system, metering errors, or unmetered use). Based on analysis of local water use records, 8 percent of the total water delivered is unaccounted-for water use.

- *Agricultural*—Only small pockets of agricultural land remain in the northern portion of the county. Regression analysis of agricultural water use in this zone and agricultural jobs showed good correlation, so this relationship and agricultural jobs as projected by ABAG were used to project agricultural water use.

The southern portion of the county is more rural than the north, and the majority of water use is agricultural. Because of the limited data record and the importance of agricultural water use in this zone, a more rigorous analysis was performed. The base acreage of irrigated land was estimated using land cover maps developed by the California DWR and checked against aerial photographs of the area. The conversion of agricultural land to other uses, as indicated by the general plans for the cities of San Jose, Gilroy, and Morgan Hill, was accounted for in the projections of future agricultural acreage. An average per-acre water use of 1.8 af/year/acre was used to project future water use, based on analysis of actual per-acre water use by crop for the zone and the cropping patterns characteristic of the zone.

Demand Reductions Due to Plumbing Code Changes

Adjustments to the base projection have been made to account for the use of water-conserving devices in new construction, as mandated by changes in the plumbing code. In addition, a toilet and showerhead replacement rate of 2 percent per year in existing residences was assumed. Together, these adjustments total 28,000 af/year by year 2020.

The 1981 plumbing code change required the use of low-flow showerheads in new construction. These units use about 2 gallons per minute (gpm) rather than the 6 to 7 gpm used by previous units. The resulting savings are about 16 gallons per household per day. The 1991 plumbing code change requires the use of ultra-low-flow toilets (ULFTs) in new construction. These units use less than 2 gallons per flush, compared to 3.5 to 7 gallon per flush for older toilets. This results in savings of 44.6 gallons per household per day.

TABLE 5.2
Water Demand Projections
(Average Weather Conditions)

	Year	Projected Water Demand (in Thousands of Acre-Feet)					
		Residential	C & I	Unaccounted	Agricultural	Savings From Code Changes	Total
North County	1990	181	128	25.7	6.4	2.6	339
	2000	202	150	29.2	5.7	12.3	375
	2010	214	167	31.7	4.3	19.2	398
	2020	222	184	33.7	3.0	24.6	419
South County	1990	11.2	4.7	1.3	60.8	.1	78
	2000	16.8	10.4	2.3	54.5	1.2	83
	2010	26.1	14.7	3.4	48.1	2.4	90
	2020	34.2	19.1	4.4	41.8	3.5	96
Total	1990	193	132	27.0	67.2	2.7	417
	2000	219	160	31.5	60.2	13.4	458
	2010	240	182	35.1	52.5	21.7	488
	2020	257	203	38.2	44.8	28.1	515

FUTURE WORK

The water demand projections presented incorporate the demographic data available at the time of the analysis. The projections will be updated periodically as additional data on demographic changes and water use patterns become available. Recommended future work includes the following:

- *Collect Additional Water Use Data*—Water use data by customer classification is essential for accurate water demand projections and verification. Collecting more detailed water use data will require a cooperative effort with the retailers in the county.

- *Update Demographic Data*—Periodically, the demand projections will be updated to include the most recent demographic data available. The current demand projections were based on demographic data from the 1980 Census and ABAG Projections 90. The next update will use demographic data from the 1990 Census and ABAG Projections 94.

- *Refine Demand Model*—The collection of additional water use data will enable future demand projections to be calibrated on multiple retailer service areas. The water demands for the commercial and industrial classifications will be explored in greater detail and the base year for calibration will be updated. Continual improvement of the projection methods and investigation of the latest version of IWR-MAIN are recommended.

1975 MASTER PLAN WATER DEMAND PROJECTIONS

The 1975 Master Plan projected the county would need 545,900 af by year 2020. Of the year 2020 demand of 545,900 af, 463,500 af is M&I water demand and 82,400 af is agricultural water demand.

The 1975 Master Plan projections assumed that three changes from pre-1970 water use patterns would occur due to future conservation efforts. First, contrary to the trends observed at the time, the county's per capita residential water use was not expected to increase. This assumption was estimated to produce a water savings of 35,000 af/year by the year 2020. Second, by the year 2020, outdoor water use was expected to decrease by 11,000 af per year due to voluntary installation of low-water use landscaping. Third, the implementation of the water production charge in South County was expected to result in an annual water use reduction of 20,000 af by the year 2020. These savings, totaling 66,000 af/year by year 2020, are reflected in the estimated total county demand of 545,900 af/year in year 2020.

Water use data has not been available in sufficient detail to track the changes in residential, outdoor, and South County water use anticipated by the 1975 Master Plan. However, prior to the 1987 drought, the 1975 Master Plan projected total water use had been tracking well with recorded water use. Recorded water use was within 2 percent of projected use for the Santa Clara Valley subbasin in 1987, the last year before the recent drought. However, the projected water use by use category and by subarea were diverging from actual water use. The updated projections reflect a more sophisticated approach and more current demographic information.

HOW THE PROJECTIONS AND THE 1975 MASTER PLAN PROJECTIONS COMPARE

The overall water demand projected in this study represents a 6 percent decrease from the projections contained in the 1975 Master Plan. For year 2020, the total water demand projected in the current analysis is 515,000 af, compared to 546,000 af in the 1975 Master Plan.

Although the total projected demand is similar, differences exist among the demand components. The agricultural projections (45,000 af by year 2020) are significantly lower than the 1975 Master Plan projections (82,000 af by year 2020) for two reasons. First, the total irrigated acreage is less than previously projected. Significant portions of South County are now expected to become low-density residential rather than remain agricultural, as was assumed in the 1975 Master Plan. Second, the agricultural per acre water use coefficient used in the updated projections is lower than that used in the 1975 analysis.

The two sets of projections also anticipate different patterns of future growth. The projections show greater water use in the West Valley area of the county and less in South County than the 1975 Master Plan projections. The 1975 analysis underestimated the growth that was to occur in the West Valley area; for example, it underestimated the actual 1980 West Valley water use by 5 percent. On the other hand, the 1975 Master Plan projections for South County (126,000 af by year 2020) are significantly higher than the projections for South County (96,000 af by year 2020). Although more agricultural land has converted to other uses than anticipated by the Master Plan, much of the growth in South County has been low-density residential and the population there has not grown as rapidly as forecasted in the Master Plan.

SUMMARY

The District's last comprehensive water supply plan was developed in 1975 and guided District operations for nearly two decades. In 1993, the District analyzed the county's future water needs based on historical water use trends and recent demographic information. The analysis found that the county will need a total of 515,000 af of water in the year 2020, compared to 546,000 af anticipated by the 1975 plan.

The demand projection represents the demand expected under average weather conditions if no conservation efforts are taken beyond the savings of 28,000 af expected from plumbing code changes regarding low-water-use fixtures. For very wet and very dry weather conditions, the updated total demand projection ranges from 495,000 to 537,000 af.

Chapter ⑥

Existing & Projected Water Supplies

Chapter 6
EXISTING AND PROJECTED WATER SUPPLIES

This chapter describes the water design criteria the District developed to plan for dry periods. It describes Santa Clara County's existing local and imported water supplies and explains how the District estimates the amount of water available from these sources. And, it evaluates the impacts of Delta water quality standards and provides estimates of the imported water deliveries the District can expect from the Delta under various regulatory and hydrologic scenarios. The water supply estimates described in this chapter serve as a basis for the assessment of the county's need for additional water supplies, which is described in Chapter 7.

INTRODUCTION

California is a semiarid area with the rainfall/snowfall occurring from October through April; however, 70 percent of the precipitation occurs between the months of December and March. Water supply for the county is a function of the amount of precipitation that falls both locally and in the watersheds of the Sierra Nevada Mountains. From the 118 years of recorded rainfall in the county, the average rainfall is about 14 inches and has a range from a low of 4.8 inches in 1 year to a high of over 30 inches.

Figure 6.1 shows the variability in historical rainfall that has occurred within the county and also reflects the variability of precipitation within the state. During very wet years, like 1983, in which 30.25 inches of rain fell and generated more water supply than could be put to beneficial use, the excess water created flooding throughout the county and the state. But in very dry years, such as 1976 when only 5.77 inches of rain fell, the water supply generated was extremely low and produced drought conditions throughout the state. This variability in water supply forces a variety of questions upon California's water utilities: what supply conditions should their systems be designed to withstand? Should the estimated supply be a long-term average or a specific drought event? If a drought event is to be used for the design criteria, which one should be selected?

FIGURE 6.1
Historical Rainfall

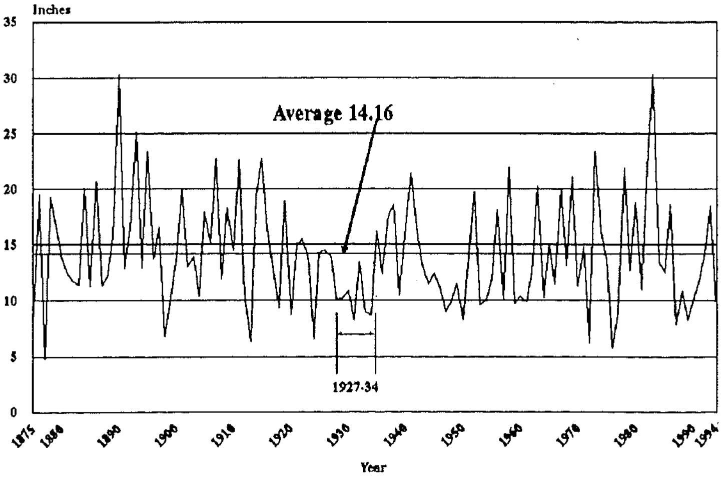


Figure 6.1

The District has undertaken to answer these questions for Santa Clara County's water supply. District staff has analyzed County hydrology and developed a statistical approach to evaluate the duration and severity of dry periods. This approach considers how often drought events have occurred and whether they are frequent enough to warrant designing the utility's system to withstand them; how much existing supply is available during a drought; and what duration of drought should be designed for.

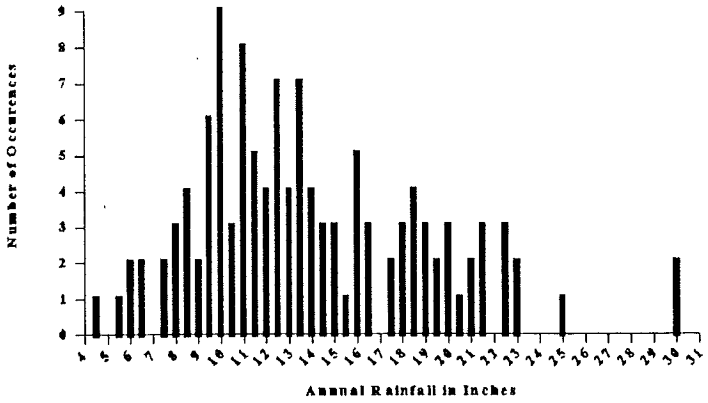
HYDROLOGICAL DESIGN CRITERIA

Evaluating the availability of the county's existing and projected water supplies requires an understanding of the driest periods that can probably be expected to occur: the design critical dry period. The District has developed a method to evaluate dry periods by using a statistical analysis for the Utility's water supply. One hundred and eighteen (118) years of local historical rainfall record were analyzed to evaluate dry periods. Grouping the data in Figure 6.1 into a rainfall histogram or the number of occurrences for specific rainfall amounts is shown in Figure 6.2. This figure again shows the variability of rainfall but also shows the data is not a normal distribution but has a positive skewness; that is, more drought events than flood events have occurred.

FIVE MAJOR FACTORS THAT AFFECT THE DESIGN CRITERIA FOR A CRITICAL DRY PERIOD

- ***Occurrence—The frequency with which drought events reoccur.***
- ***Antecedent Conditions—The amount of water supply available to a system before entering into a drought.***
- ***Supply Severity—The amount of water supply that is generated during the drought.***
- ***Storage Capacity—The system's ability to store water that will be used during the drought period.***
- ***Duration—The length of time the drought lasts.***

FIGURE 6.2
Historical Rainfall Histogram



From the analysis of these rainfall events, five major factors affect the design criteria for a critical dry period. These factors are (1) the occurrence or frequency of these drought events; (2) the initial conditions of the system entering into a drought period; (3) the amount of water supply that enters the system during the drought event; (4) the amount of water that is stored preceding a drought event to be used to alleviate the event, and (5) the duration of the drought before normal rainfall conditions return to alleviate the dry situation.

From this analysis, the criteria for a critical dry period has been determined to be a drought event with a supply severity of 1-in-100 and a duration of 10 years. A supply severity of 1-in-100 means that about 100 times in 10,000 years there will be periods of equal or lower levels of water supply. The rationale for this design criteria follows:

Occurrence

The historical rainfall, as shown in Figure 6.1 is an indication of the variability of water supply in California. In fact, over the 118 years of rainfall record, seven major drought events has occurred, which have lasted from 1 to 10 years. The supply severity of 1-in-100 or greater in severity has occurred in four of these seven drought periods. One major drought, the 1927-34 event, accounts for five of the supply severity events and is the drought event used by the State to determine the firm yield from the State Water Project. Table 6.1 shows four different drought events with one of these events lasting 10 years from the historical drought occurrences of this 118 years of record. Because of these frequent occurrences of droughts, the District's Water Utility should be designed to withstand a critical dry period and not simply an average water supply condition.

TABLE 6.1
Historical Drought Occurrences

Length of Drought	Average Rainfall (inches)	Seasonal Years	Supply Severity	Rainfall for 1 in 100 Severity
1 year	4.83	1877	1 in 541	5.91
2 years (short-term)	7.38	1976-77	1 in 214	7.88
3 years	9.00	1987-89	1 in 65	8.71
4 years	9.26	1987-90	1 in 118	9.36
5 years (mid-term)	9.78	1987-91	1 in 86	9.69
6 years	10.06	1929-34	1 in 81	9.94
7 years	10.07	1928-34	1 in 120	10.17
8 years (long-term)	10.54	1927-34	1 in 78	10.44
9 years	10.98	1926-34	1 in 56	10.68
10 years	11.09	1924-33	1 in 7	10.92

Antecedent Conditions

Antecedent or initial conditions can impact the severity of the drought for a water utility. Antecedent rainfall dictates the amount of supply that is available to the utility before a drought begins, which relates to the amount of water the utility can store and have available to be used through the drought. The initial conditions for the drought that started in 1987 were extremely different than the initial conditions for the 1927-34 drought. As seen from Figure 6.1, the 1927 drought had average to below average rainfall as its antecedent condition, whereas the years prior to the 1987 drought were very wet. Hence, the supply available to the utility prior to the 1987 drought would have been much greater than for the 1927 drought.

Supply Severity

The amount of water supply generated during a drought determines the severity of supply for the event. From a review of the statistical information developed and compared over multiple-year droughts, the District defined a design critical dry period to have a supply severity of 1-in-100. A 1-in-100 supply severity means that about a 100 times in 10,000 years, there will be events with equal or lower levels of water supply. The duration of the event can be 1, 2, 3, or more years and each of these durations has its own 1-in-100 severity. This severity level of supply has been observed historically with at least seven major drought events. The 1927-34 drought had a supply severity of 1-in-120 and was the impetus for the creation of the District. Figure 6.3 shows the statistical supply severity generated from all of the events in the 118 years of record. The rainfall for multiple year droughts is the average of the rainfall during the drought event. The central limit theorem states that as more data is averaged the more the average value tends to the average value of the entire data set. Hence, a 5-year drought has a greater average rainfall than a 1-year drought of the same severity.

FIGURE 6.3
Severity of Supply

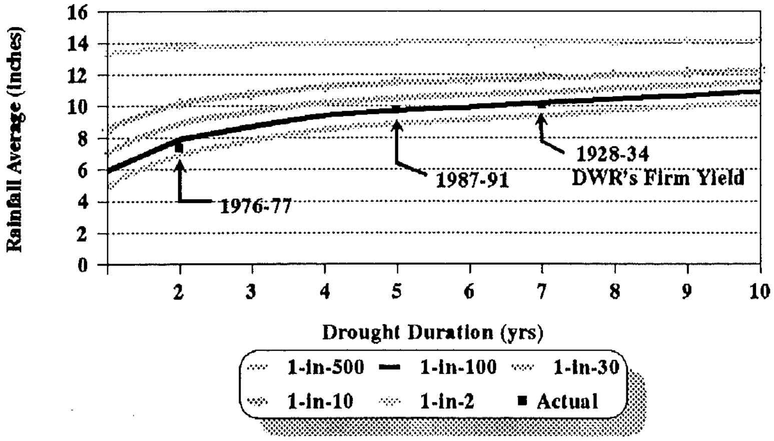


Figure6.2

Storage Capacity

The amount of storage capacity in the system affects its ability to cope with a drought event. If a utility has no capacity to store water, then it can have no carryover storage from one year to the next. Hence, the supply severity of a 1-year drought would be the worst drought for a system with no storage because it generates the least amount of water supply. This supply would have to satisfy all the water needs of the community for that year. A system with a large storage capacity could store a great amount of carryover storage in comparison to water needs and could go through short-term droughts by borrowing from this storage. The worse drought for this system would be a drought of long-term duration when finally all of the utility's carryover storage had been used. Hence, the design critical dry period is dependent upon the water utility's storage capacity versus water needs and is unique for each utility.

Duration

The critical duration of a drought that a utility must cope with depends upon the individual system and the hydrology encountered; that is, the amount of storage capacity the utility has and the antecedent water supply before the drought event that could fill this storage capacity and provide stored water for later use. After analyzing the historical data, it was determined for the District's Water Utility system that a 10-year drought event should be the duration of the design critical dry period. The 10-year duration extends the drought to a point at which all of the District's carryover storage is used and the recovery of the system's storage begins to take place, usually between the seventh and eighth year of the drought. This recovery is due to the increasing amount of rainfall with longer duration droughts. The water supply solution required to alleviate the drought provides enough water to fill the District's storage capacity before the drought event begins, even before the 1927-34 drought event. Hence, with full storage just prior to any drought, the supply solution is independent of the antecedent conditions.

The outcome of this analysis—the design criteria of 1-in-100 severity and 10 years duration—assumes certain conditions for local hydrology and District storage capacity. This design criteria must be reviewed if these assumed conditions change; for example if the ''green-house effect'' reduces the county's water supply in the future, or if the storage capacity of the District's system is reduced by groundwater contamination.

LOCAL SUPPLIES

WHAT IS "YIELD?"
In water supply planning, "yield" means the amount of water that can, on a long-term basis, be put to beneficial use. For surface water, this means the amount of surface flow that can be diverted to a reservoir, water treatment plant, or groundwater recharge facility and does not flow to the Bay. For groundwater supplies, yield means the average amount of water that recharges the groundwater basins on the long-term basis from direct precipitation, irrigation return flows, runoff from minor tributary drainage areas, and subsurface inflows from adjacent areas.

The County's Hydrologic Data Record

The County's local water supply comes from rainfall and the ensuing surface water runoff and natural groundwater yield. Identifying historical availability of these resources allows the District to develop forecasts about how much local water yield can be expected under various hydrological conditions. To determine how much surface water has historically been available, the District relies on records of rainfall, surface flow, pumping, and artificial recharge; these, in turn, are used to calculate annual groundwater yield.

The hydrologic data available for Santa Clara County is incomplete. While there are 118 years of continuous rainfall data at one site in San Jose, most of the data from streamflow and reservoir inflow dates only as far back as the 1930s or 1940s, and records for some streams and reservoirs begin as late as 1962. The years 1967 to 1993 are the only ones in which all local hydrologic data is available, and the only period for which the county's historic natural groundwater yield can be calculated. Hence, these years are used as a basis for the historical supply of the county's various water resources and as an estimate for the type of supply that the county will encounter in the future.

Surface Water Yield

The District's local surface water supplies include the streamflows that feed into and out of the District's reservoirs, streamflows that are not captured by reservoirs, and water that flows overland into reservoirs. The average surface flow in the county, based on the hydrologic data for the period 1967 to 1991, is about 193,700 af/year. On average, less than half of this water supply, or 91,000 af/year, can be captured and put to beneficial use through surface diversions and/or groundwater recharge. During a dry period, the surface water flow and the yield are approximately the same; that is, no water is lost to the San Francisco or Monterey Bay (the Bay). The yield averages only 54,000 af/year during a dry year.

This shortfall on the long-term average yield is due in part to the limits of the District's storage, recharge, and conveyance capacities. Some dams and reservoirs are not large enough to capture all of the reservoir inflows that could then be put to beneficial yield. If a reservoir spills frequently, much of the flow that could have been developed into yield will instead flow to the Bay. Or, the yield of a stream system might be limited due to the downstream recharge capacity. If streamflows are much higher than the recharge capacity, much of the flow will not be developed into water supply yield. If more recharge capacity were developed on these streams, then more of the available local streamflow could be recharged into the groundwater basin.

A comparison of the District's local surface water flows and yields appears in Table 6.2. Several surface water components are listed in this table. The first, unregulated streams, do not flow into or out of a reservoir. The next component, regulated streams, include reservoir inflow, which flows from creeks and over land into a reservoir, and downstream accretions, which enter a regulated stream downstream of a dam.

TABLE 6.2
Historic SCVWD's Surface Water Supply

Facility	Average Surface Flow (af/year)	Average Local Yield (af/year)	Yield as Percentage of Surface Flow
UNREGULATED STREAMS			
Regnart Creek	200	100	50%
Calabazas Creek	700	500	71%
Rodeo Creek	30	30	100%
Saratoga Creek	6,100	1,900	31%
Wildcat Creek	1,500	200	13%
San Tomas Creek	1,600	300	19%
Ross Creek	900	700	78%
Penitencia Creek	4,300	900	21%
Thompson Creek	900	400	44%
Silver Creek	1,600	500	31%
SUBTOTAL	**17,800**	**5,500**	**31%**
REGULATED STREAMS			
Stevens Creek Total		3,300	32%
Reservoir Inflow	10,400		
Los Gatos Creek Total		16,600	74%
Reservoir Inflow	21,900		
Downstream Accretions	400		
Guadalupe River Total		5,500	60%
Reservoir Inflow	4,900		
Downstream Accretions	4,200		
Alamitos Creek Total		4,400	38%
Reservoir Inflow	10,900		
Downstream Accretions	800		
Calero Creek Total		4,000	54%
Reservoir Inflow	4,200		
Downstream Accretions	3,200		
Coyote Creek Total		34,700	65%
Reservoir Inflow (Coyote)	31,900		
Reservoir Inflow (Anderson)	21,100		
Llagas Creek Total		9,000	87%
Reservoir Inflow	10,400		
Uvas Creek Total		8,000	16%
Reservoir Inflow	27,100		
Downstream Accretions	24,500		
SUBTOTAL	**175,900**	**85,500**	**49%**
TOTAL SURFACE SUPPLY (AF/YR)	**193,700**	**91,000**	**47%**

San Jose Water Company has developed 9,500 acre-feet of water on the average from a run-of-the-river treatment facility on Saratoga Creek but the majority from their Elsman Reservoir in the Los Gatos Creek watershed.

FLOW VERSUS YIELD IN WET AND DRY YEARS
Through the District's existing reservoir and percolation pond system, less than half of the average surface flows are actually developed into local water supply yield. Due to existing reservoir and groundwater recharge capacities and the historic pattern of surface runoff, the remaining surface flows go to the Bay. During years of high rainfall, high surface flows occur which cannot be captured in existing reservoirs. However, during a critical dry period, most of the local surface runoff is developed into local yield, and the flows to the Bay are low.

Potential Sources of Additional Surface Water Yield

The far right column in Table 6.2, "Yield as Percentage of Surface Flow," shows that the existing reservoir systems of Stevens Creek, Alamitos, and Uvas have the lowest yields for their surface flows, all well below 50 percent, and thus could provide the most additional yield to the District. Adding recharge facilities or local reservoir storage in these systems would develop additional local yield on an average basis. However, because most local flows are fully utilized during dry years, new facilities on these systems may not increase supply during a critical dry period.

Groundwater Yield

Recharge to the groundwater basin consists of both natural groundwater recharge and artificial recharge of local surface and imported water. Natural groundwater recharge includes recharge from rainfall, net leakages from pipelines, seepage from the surrounding hills, seepage into and out of the groundwater basin, and net irrigation return flows to the basin. Artificial recharge is controlled recharge that occurs in specific streams and percolation ponds.

The District tracks artificial recharge on a monthly basis. Because natural groundwater recharge occurs over the entire valley floor, it cannot be directly measured. Instead, the District estimates this supply source by subtracting the amount of artificial recharge and groundwater pumping that occur over a given time period from the change in groundwater storage during that period. The change in groundwater storage is determined from tracking the water levels in hundreds of wells throughout the county.

This computation requires that the amount of groundwater pumping be known. Groundwater pumping data has been available since 1967 for the Santa Clara Valley Subbasin. But it has just recently begun to be collected for the Coyote and Llagas Subbasins. In the past, the District has calculated estimated natural groundwater recharge by estimating agricultural pumping from crop planting data for both the Coyote and Llagas Subbasins. The long-term and critical dry period average natural groundwater recharge for these three subbasins are shown in Table 6.3.

TABLE 6.3
Natural Groundwater Recharge
(thousands of af/year)

Subbasin	Santa Clara	Coyote	Llagas	Total
Average	62.9	4.9	44.3	112.1
Critical Dry Period	41.4	3.2	29.1	73.7

A method to more accurately compute natural groundwater recharge is under development for the Santa Clara Valley Subbasin as part of the District's groundwater model project. This new method uses rainfall and water use data to estimate each component of recharge. The assessment of this method and application of it to estimating water supply will be an element of future work.

Reclaimed Water

Wastewater reclamation is a local water source that has been added to the county by the four water pollution control plants. The four local water pollution control plants have developed 2,000 acre-feet of nonpotable reclaimed water within their service areas and are planning to develop even more.

IMPORTED SUPPLIES

SOUTH BAY AQUEDUCT
A 40-mile long facility that brings water from the California Aqueduct near Tracy, through Livermore Valley, to a terminus in east San Jose just north of Penitencia Creek. Water from the San Joaquin-Sacramento Delta is pumped into the California Aqueduct and then into the South Bay Aqueduct. Beginning deliveries to Santa Clara County in 1965, the ultimate delivery capacity of the project for Santa Clara County is 100,000 acre-feet. The project is owned and operated by the State Department of Water Resources.

The county receives imported water from the SWP, the federal CVP, and the City and County of San Francisco's Hetch Hetchy system. The District has contracts for 100,000 af/year of water from the SWP and 152,500 af/year from the CVP. The District does not control or administer Hetch Hetchy deliveries to the county; deliveries have averaged approximately 76,000 af/year.

The District receives its SWP deliveries via the Bank's pumping plant located in the southern Delta. The SWP has developed only about half of the firm yield required to meet the current and future quantities of water that the project has contracted to deliver. DWR has been investigating projects in the Delta to increase conveyance, banking water in the groundwater basin in Kern County, and constructing a new reservoir at the Los Banos Grande site with the intent of meeting commitments in the future. None of these projects has yet started. The District's imported CVP deliveries originate from the Tracy pumping plant, which is also located in the southern Delta. Hetch Hetchy imported deliveries originate in the Tuolumne River watershed high in the Sierra Nevada mountains and are transferred directly by closed conduit to the Bay Area.

SAN FELIPE
A water delivery system that brings water stored in San Luis Reservoir to Santa Clara County. The project consists of 6.3 miles of tunnels, two pumping plants with a total of 34,000 horsepower to lift water as much as 308 feet, and 29 miles of pipe ranging in size from 8 to 10 feet in diameter. The project terminates near Coyote Creek just west of Anderson Dam. Beginning deliveries to Santa Clara County in June 1987, the current delivery capacity of the project for Santa Clara County is 152,500 acre-feet per year. The San Felipe Project is part of the Central Valley Project, built by the U.S. Bureau of Reclamation and now operated by the Santa Clara Valley Water District.

The water that is exported from the Delta by the Banks and Tracy pumping plants must traverse a myriad of channels and is subject to multiple uses. Flows from the Sacramento and San Joaquin Rivers enter the Delta carrying traces of saline agricultural runoff, pesticides, heavy metals from mine seepage, upstream wastewater treatment plant discharge, and juvenile fish from upstream spawning areas. After this water enters the Delta, the water in the Delta channels may be utilized for in-Delta agricultural irrigation. Once used, the tailwater from this irrigation is then returned to the Delta system for further use.

The SWP and CVP pumping plants can affect flow patterns and water quality in the central and western Delta during periods of low water inflow to the Delta. As pumping increases in the southern Delta, saline water from San Francisco Bay can be drawn upstream into the Delta channels. Saline water not only degrades the freshwater supplies within the Delta but adversely affects fish and wildlife.

The SWP and CVP are subject to regulations by state and federal agencies to protect the water quality and fish and wildlife resources of the Delta and upstream watersheds. These regulations combine upstream flow requirements, Delta outflow requirements, pumping limitations, maximum salinity concentrations, physical barrier operation constraints, and limits to the impacts on the fisheries within the Delta. They limit the ability of the SWP and the CVP to export water from the Delta, making it difficult for the SWP and CVP to meet their delivery obligations thereby reducing the reliability of those deliveries.

Delta Water Quality Standards

The following is a detailed chronological summary of the Delta water quality standards that have been developed since 1975.

The agencies regulating water use from the Delta are the SWRCB, the California Department of Fish and Game, the U.S. Fish and Wildlife Service (USF&WS), the U.S. National Marine Fisheries Service (NMFS), the U.S. EPA, and the Corps.

In 1975, the SWRCB issued the "Sacramento-San Joaquin Delta Basin Plan." This plan provided protection of the Delta's beneficial uses of water supply, agricultural irrigation, and fish and wildlife through a set of water quality objectives. In conjunction with the plan, a water right decision was issued that required the SWP and CVP to meet certain water quality objectives.

In 1978, the SWRCB adopted an amended Delta Plan. This amended plan is commonly known as the "Delta and Suisun Marsh Plan." Water right decision 1485 (D-1485) was issued with the plan to meet both salinity control and fish and wildlife protection in the estuary. The D-1485 standards are generally based on the degree of protection that municipal, industrial, agricultural, and fish and wildlife uses would have otherwise experienced had the SWP and CVP not been built.

Recognizing the complexities of project operations and that water quality conditions would change over time, the SWRCB also specified that the Delta water right permit hearings could be reopened, depending upon how conditions in the Bay/Delta region changed.

Hearings to adopt a new Water Quality Control Plan and water rights decision for the Bay/Delta estuary began in July 1987. The SWRCB released two reports in November 1988: a draft "Water Quality Control Plan for Salinity" and a "Pollutant Policy Document." The Pollutant Policy Document was subsequently adopted in June 1990. The draft Water Quality Control Plan, however, was a significant departure from the 1978 plan and generated considerable controversy.

WHICH REGULATIONS WILL GOVERN DELTA EXPORTS? It is clear that some form of the ESA/NMFS winter-run salmon requirements, USF&WS's Delta smelt habitat requirements, and EPA's proposed regulatory standards will be the operational constraints imposed until the health of the estuary recovers. Each of these regulatory requirements has a profound water supply impact. As these requirements evolve and conditions in the Delta change, the District's estimated imported water supply from the CVP and SWP will also change. Keeping abreast of possible changes requires the District to monitor the progress of all regulations that affect the county's water supply.

In January 1989, the SWRCB decided to significantly amend the draft Water Quality Control Plan. The water quality phase was to continue, an additional scoping phase would follow, and issues related to flow were to be addressed in the final water rights phase. The SWRCB adopted the final Water Quality Control Plan in May 1991; it was subsequently rejected by the EPA. The SWRCB began the scoping work for an EIR with the intention to adopt the EIR and water right decision by the end of 1992.

In April 1992, the governor issued a water policy statement that directed the SWRCB to establish interim Bay/Delta standards. These interim standards were intended to be in place for 5 years, during which time the SWRCB was to develop long-term standards. Draft interim standards (proposed D-1630) were released in December 1992. Concurrently, under the authority of the Endangered Species Act (ESA), the federal regulatory process was proceeding toward development of Delta standards and upstream measures applicable to the SWP and CVP to protect the threatened winter-run Chinook salmon.

In addition to the regulatory process, federal legislation was proposed to reform the CVP. In October 1992, federal legislation was enacted which dedicated 800,000 af/year of firm yield from the CVP for environmental purposes. This act, known as the Central Valley Project Improvement Act (CVPIA), dedicates 600,000 af/year to in-stream fisheries. The remaining 200,000 af/year are split among pumping limits, wildlife habitat, and refuge allocations, with allocations among these uses varying annually. The CVPIA also required the U.S. Bureau of Reclamation to find ways to make up this loss of water to the contractors.

Under the ESA, NMFS issued a biological opinion governing operations of the CVP and SWP in February 1993. The Delta environmental regulations were, in certain months, more restrictive than the SWRCB's proposed D-1630 measures. In April 1993, the USF&WS officially listed the Delta smelt as a threatened species. In May, the USF&WS issued a biological opinion on the CVP and SWP operations with conditions designed to protect the Delta smelt and its habitat for 1993 to 1994. The conditions were generally more restrictive than the SWRCB's proposed D-1630 standards.

In April 1993, the governor asked the SWRCB to withdraw its proposed D-1630 standards and focus on establishing permanent standards for Delta protection since recent federal actions had effectively preempted state interim standards for protection of the Bay/Delta environment.

In December 1993, under the authority of the federal Clean Water Act, the EPA proposed three sets of criteria for the Delta. They consist of a salinity criteria for the western Delta (Suisun Bay), survival targets for migrating young Chinook salmon, and salinity criteria to protect striped bass spawning areas on the lower San Joaquin River. Currently the EPA and DWR are discussing ways to make this operational in the Delta.

The 1994 operations of the Delta are currently governed by D-1485 with the ESA's requirements of reasonable and prudent changes to accommodate the winter-run salmon and the Delta smelt and must also accommodate the CVPIA requirements.

Estimating Regulatory Impacts on the District's Imported Supplies

All of the recent regulatory actions have limited the water supply available from the CVP and SWP. These impacts are manifested at the local level as reductions in project deliveries and correspondingly supply reliability for Santa Clara County.

DWR conducts operational simulation studies to estimate the water supply impacts of regulations on the SWP and CVP. These studies utilize historical hydrology and existing water supply facilities for the projects. Superimposed on the historical hydrology and existing facilities of the SWP and CVP are delivery obligations, water quality standards, and fisheries protection regulations. The simulation studies are conducted on a monthly basis for a 71-year historical period. The results identify the amount of water that could be exported by SWP and CVP from the southern Delta while remaining in compliance with each set of regulations.

DWR furnishes the District with this export data, and staff then applies the project delivery shortage rules to the pool of available water that has been identified in the DWR studies. Through this process, the District can estimate the local imported supply impacts associated with the regulations.

Imported Supply Estimates

The District's SWP and CVP imported supplies continue to be reduced with each set of regulatory requirements that are imposed on the projects. Table 6.4 identifies the District's imported supplies for the SWP and CVP during two hydrologic periods (a long-term average basis and a design critical dry period) under three different Delta water standards. It also identifies the minimum deliveries associated with each standard. This information illustrates the extreme variability of imported SWP and CVP deliveries to the District.

TABLE 6.4
Comparison of Delta Regulations (thousands of af/year)

	State Water Project			Central Valley Project			Both Projects
	LTA	CDP	MIN	LTA	CDP	MIN	CDP
Entitlement	100	100		152.5	152.5		252.5
D-1485	80	62	18	140	103	57	165
ESA (existing)	77	55	11	127	85	31	140
EPA (proposed)	72	45	6	102	62	8	107

The water supply impacts of the existing (D-1485 with the ESA requirements) and proposed (EPA) regulations are shown in Figure 6.4. The figure illustrates the cumulative SWP and CVP imported supply reductions associated with each set of regulations imposed on the projects' operations. This figure does not include the reductions in the Hetch Hetchy deliveries to the county as proposed by the EPA's standards, as those supply impacts currently cannot yet be identified. The historical deliveries have been used to estimate the Hetch Hetchy supplies to the county. The maximum delivery into the county has been 76,000 af/year and the average delivery during the design critical dry period is 66,500 af/year.

FIGURE 6.4
SWP and CVP Reductions Due to Regulatory Impacts

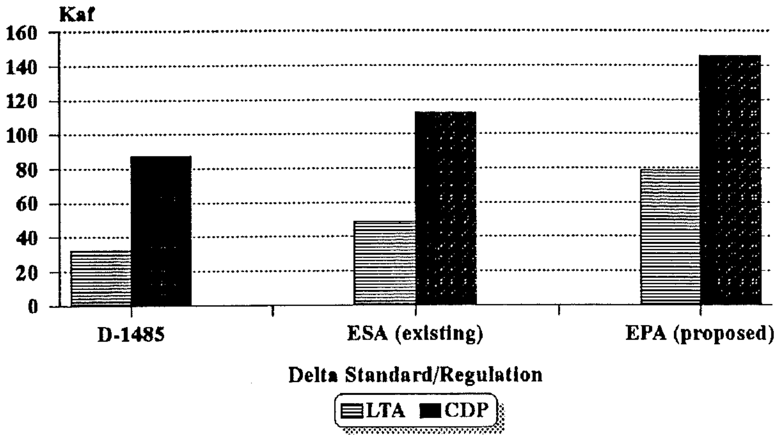


Figure 6.3

Imported Supply Uncertainty

The supply impacts identified above are not complete because several additional considerations cannot yet be quantified:

- *Future Regulations*—Regulations in the Delta may not have the desired effect of restoring the estuary's ecological health. If not, more stringent requirements might be imposed. If the regulations currently imposed do restore the estuary, then less stringent requirements may be imposed.

- *Take Limits*—Under the ESA "take limits" on the endangered winter-run salmon or Delta smelt, scheduled SWP and CVP water deliveries from the southern Delta can be interrupted. Suspending scheduled deliveries has a twofold effect: (1) The water supplies that were scheduled to be delivered for the period of interruption need to be made up at a later time (hydrology permitting) and (2) the interrupted scheduled water that now needs to be delivered at a later time must take priority over north-to-south water transfers. The effect of this is to reduce the opportunity to pump north-to-south transfer water which may be intended to mitigate the supply impacts associated with the EPA's Delta water quality standards.

- *CVPIA*—The CVPIA requires that 800,000 af/year of firm yield from the CVP be designated for environmental purposes. It is not clear whether or not this water could be used to mitigate some of the supply impacts associated with the ESA criteria or the proposed EPA standards. The CVPIA requirements may also further reduce the amount of water available for export. The CVPIA requires the Bureau to find ways to make up this loss to water contractors, but it is unclear if this will occur and how it will impact the District.

- *Central Valley Project Municipal and Industrial (CVP M&I) Shortage Policy*—The District has been in negotiation with the Bureau of Reclamation regarding an M&I water shortage policy. The policy would serve to firm up CVP deliveries to the District by defining a delivery floor based on natural statewide hydrology and the regulatory requirements imposed on the CVP. These negotiations have not been concluded and the policy is not yet final.

- *SWP*—The state still has an obligation to deliver the full entitlement of its contracts. It is unclear if and how this can be accomplished.

- *Hetch Hetchy Contributions*—Hetch Hetchy may contribute a portion of their supplies to the Tuolumne River system for the purpose of salmon smolt survival. It is not currently possible to quantify how this contribution will affect Hetch Hetchy deliveries to Santa Clara County. What can be assumed is that the Hetch Hetchy deliveries to the county will be reduced, which will require additional supplies to make up the for the shortfall.

- *Hetch Hetchy Supply Contracts*—The county municipalities receiving water from Hetch Hetchy all have contracts that are noninterruptible with the exception of the cities of Santa Clara and San Jose. During dry hydrologic periods, noninterruptible supply contracts will be reduced. However, the Hetch Hetchy deliveries to Santa Clara and San Jose that are interruptible can be discontinued at the discretion of Hetch Hetchy. This further limits the District's ability to provide a reliable supply of water during critically dry years.

Regulation Implementation

Under the ESA, regulating authorities are not required to go through a public hearing process before implementing standards. Because the EPA's standards are being proposed under the federal Clean Water Act, the SWRCB is in charge of implementing the standards. The SWRCB is also scheduled to begin a triennial review of the 1991 Delta Water Quality Control Plan. It is anticipated that implementation of the EPA's standards will be incorporated into the three phases of the triennial review associated with the Water Quality Control Plan. The process is expected to be completed in December 1995.

SUMMARY

Evaluating the availability of the county's existing water supplies requires an understanding of the driest period that can reasonably be expected to occur: the critical dry period. From review of statistical information and comparison to the most severe droughts recorded over multiple-year time periods, the District has determined that a critical dry period for the District's water supply system is the 1987 to 1991 drought extended to a 10-year duration at a 1-in-100 severity level.

The District's surface water supplies account for about half of the county's local water supply. About half of these local surface water flows to the Bay. However, during dry periods, local surface flows are fully captured and put to use. Thus, expanding local reservoir storage or adding recharge facilities would develop additional local yield on an average basis but would not increase supply during a critical dry period.

Local groundwater yield during a critical dry period is 73,700 af/year and on the long-term average the yield is 112,100 af/year. It has been assumed in this study that all of the operating storage of the basins can be used and no reservations have been made for emergency storage.

The District's imported supplies travel from the Delta through the CVP and SWP. The SWP and CVP are subject to state and federal regulations for protection of water quality and fish and wildlife resources of the Delta and upstream watersheds. Deliveries from the Delta are currently restricted under D-1485, the ESA's requirements to accommodate the winter-run salmon and Delta smelt, and the CVPIA requirements. The EPA has proposed regulatory standards which are more stringent than existing standards. In the likely event that the EPA standards are adopted, the total water supply available to the District from the Delta through the SWP and CVP will be 107,000 af/year during a critical dry period. Historically, Hetch Hetchy has delivered an average of 66,500 af/year during a dry period.

The impact of the ESA and other Delta regulations on the District's water supply is uncertain due to several factors, including regulations and agreements that are currently under negotiation. The District will continue to monitor the progress of all regulations that affect the county's water supply. Table 6.5 summarizes the water supplies for the county during a long-term average basis and a design critical dry period.

TABLE 6.5
Water Supply Summary
(thousands of af/year)

		LTA	CDP
Local Supplies	Surface Water Yield	100.5	59
	Groundwater Yield	112	74
	Nonpotable Reclaimed Water	2	2
Imported Supplies (EPA proposed standards)	State Water Project	72	45
	Central Valley Project	102	62
	Hetch Hetchy	72	66.5
TOTAL		460.5	308.5

Chapter ⑦

Water Shortage

Chapter 7
WATER SHORTAGE

This chapter summarizes the water needs and water supply findings from the preceding two chapters and describes the potential water shortages that will occur in Santa Clara County if measures are not taken to supplement water supply and/or reduce water demands. It also describes the severity and projected frequency of potential water shortages for various years from 1995 through 2020.

WATER NEEDS SUMMARY

The following summarizes Santa Clara County's projected water needs for the year 2020, which represents the ultimate foreseeable demand:

- For average weather conditions, water demand is expected to be 515,000 af/year when plumbing code changes are incorporated and during dry weather conditions the water needs is expected to be 537,000 af/year.
- Existing BMPs are expected to reduce water demands by 3,000 af/year.
- The net estimated water need for average weather conditions is 512,000 af/year and 534,000 af/year for dry weather conditions.

WATER SUPPLY SUMMARY

Imported Water Supplies

Water imported from the Delta through the SWP and CVP accounts for about half of the county's total water supplies. Chapter 6 described the impacts of various water quality standards on the District's entitlement of water from the Delta. Table 7.1 shows how the three major existing and proposed Delta water quality standards would affect District deliveries under two hydrologic scenarios: the critical dry period and long-term average.

TABLE 7.1
Imported Water Supply
Under Various Delta Requirements
(thousands of af/year)

	Entitlement	D-1485	ESA (Existing)	EPA (Proposed)
Critical Dry Period Average Supply	328.5	231.5	206.5	173.5
Long-Term Average Supply	328.5	292	276	246

As this table indicates, each environmental requirement decreases the District's estimated imported water deliveries. The EPA standards are the most stringent and result in the lowest exports from the Delta: 46,000 af/year less than deliveries under the D-1485 standard. An even greater impact occurs for water deliveries during the critical dry period, when they would be reduced by 58,000 af/year.

Total Water Supplies

Table 7.2 shows the total local and imported supplies that would be available to the county for the critical dry period and long-term average hydrology. The imported water supply estimates in this table represent the deliveries that can be expected under the proposed EPA Delta standards.

TABLE 7.2
Total Water Supply
Under EPA Delta Requirements
(thousands of af/yr)

	Total Surface Water Yield	Natural Groundwater Yield	Total Imported Water	Total Water Supply
Critical Dry Period Average Supply	61	74	173.5	308.5
Long-Term Average Supply	102.5	112	246	460.5

Table 7.2 shows that under the proposed EPA requirements, the county's total long-term average water supply is roughly 460,500 af/year. The total water supply during the critical dry period is 308,500 af/year. Water supplies during the critical dry period are of particular interest because the critical dry period serves as the design criteria and dictates the need for action for the District's water supply planning. A detailed explanation of the critical dry period appears in Chapter 6.

2020 WATER SHORTAGES

The water need and water supply allocations presented above are translated into water shortages for the year 2020 in Table 7.3. Shortage data were developed for each existing and proposed Delta standard by modeling the District's system and taking into account the groundwater and surface water storage that could be used to alleviate the shortages.

TABLE 7.3
Year 2020 Water Shortages Under Various Delta Requirements
(thousands of af/year)

	D-1485	ESA	EPA
Maximum Shortage	128	161	247
Average Shortage During a Critical Dry Period	122.5	147.5	180.5
Long-Term Average Shortage	5.5	32.5	51.5

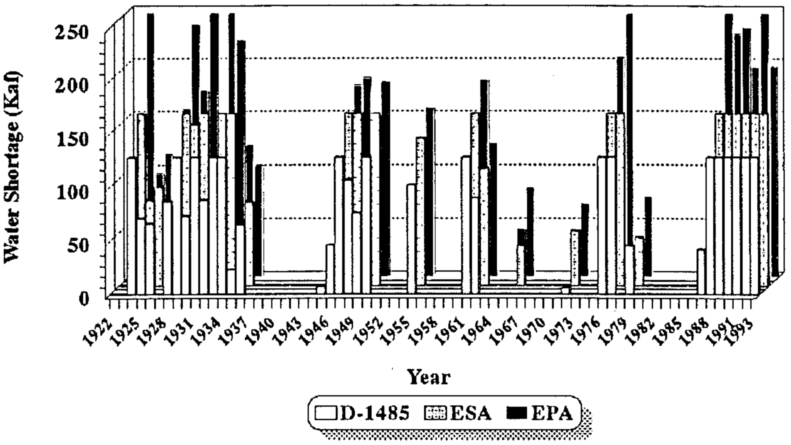
Table 7.3 shows that shortages increase dramatically under the proposed EPA requirements from the D-1485 standards. The long-term average shortage increases by 46,000 af/year for year 2020; the maximum shortage during the critical dry period increases by 119,000 af/year.

A critical dry period may span several years of varying severity. For planning purposes, it is useful to project the maximum shortage that is likely to occur during a critical dry period, and the frequency with which this maximum shortage can be expected.

To establish the severity and frequency of a maximum shortage, the District has analyzed the past 72 years of historical hydrology. Although it is not predictive, past hydrology is the best available indicator of future hydrologic trends. For each year since 1922, the District has calculated the water shortage that would occur, given the local hydrology for that year, the year 2020 estimated water demand, and the imported water deliveries that would be allowed by the EPA guidelines. Results appear in Figure 7.1.

Figure 7.1 shows maximum shortages for 6 out of the 72 historical hydrological years, or 8 percent of the time, and some type of shortage 51 percent of the time. The 1928 to 1934 and 1987 to 1993 dry hydrological years are not the only periods in which dramatic projected shortages would have occurred: the periods 1947 to 1950, 1961 to 1962, and 1976 to 1977 also would have had severe shortages. This figure demonstrates that maximum shortages are not an infrequent occurrence.

FIGURE 7.1
Water Shortages
Under Various Delta Requirements



CENTRAL VALLEY PROJECT MUNICIPAL AND INDUSTRIAL SHORTAGE POLICY

The District has recently been involved in negotiations with the Bureau to establish a CVP M&I Shortage Policy. This policy would set minimum levels of imported water deliveries to M&I users. Based on the best interpretations of the proposed policy, the District's CVP water deliveries would increase from 102,500 af/year to 117,500 af/year for the long-term average and from 62,000 af/year to 99,500 af/year during the critical dry period effectively increasing dry period supplies by 37,500 af/year. The Shortage Policy is an interim measure and will be enforce until the District renegotiates its current contract with the CVP. This contract renegotiation should begin after an environmental impact survey is completed in 1997. When the contract is renegotiated, the terms of the Shortage Policy will be finalized and should be consistent with the current policy.

The effects of the CVP M&I Shortage Policy on potential water shortages for year 2020 are shown in Table 7.4. Again, shortage calculations are based on the most stringent of the proposed Delta water quality standards, the EPA requirements. For year 2020, the policy would decrease the maximum critical dry period water shortages from 247,000 to 175,000 af/year.

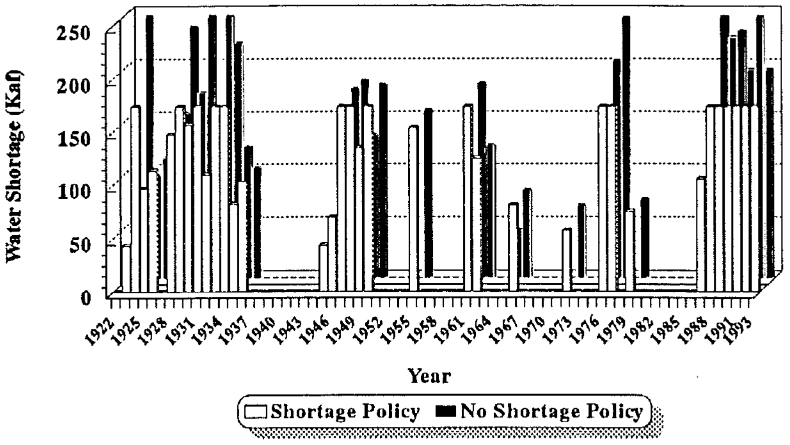
TABLE 7.4
Year 2020 Water Shortages With and Without the CVP M&I Shortage Policy, Based on EPA Delta Requirements
(thousands of af/year)

	Without the Shortage Policy	**With the Shortage Policy**
Maximum Shortage	247	175
Average Shortage During a Critical Dry Period	181	143.5
Long-Term Average Shortage	51.5	36.5

Figure 7.2 portrays the occurrence of water shortages based on 1922 to 1993 hydrology, year 2020 demand, and the EPA Delta standards, both with and without the CVP M&I Shortage Policy. The figure shows that even with the Shortage Policy, the most severe shortage of 175,000 af/year occurs 18 out of the 72 historical years (25 percent of the time) and some amount of shortage occurs 50 percent of the time. Also, the most severe shortages occur through all of the sensitive drought periods of 1928 to 1934, 1947 to 1950, 1959 to 1962, 1976 to 1977, and 1987 to 1993.

The CVP M&I Shortage Policy has the effect of lowering the severity of the water shortages and decreasing the average shortage during a critical dry period. Figure 7.2 shows that shortages of **more than** 175,000 af/year occurred in 18 out of 72 simulated years when the policy was not in effect, while shortages **equal to** 175,000 af/year occurred in the same 18 out of 72 years. Thus, the policy has the effect of limiting the impact of the severest shortages.

FIGURE 7.2
Shortages With and Without the CVP M&I Shortage Provision

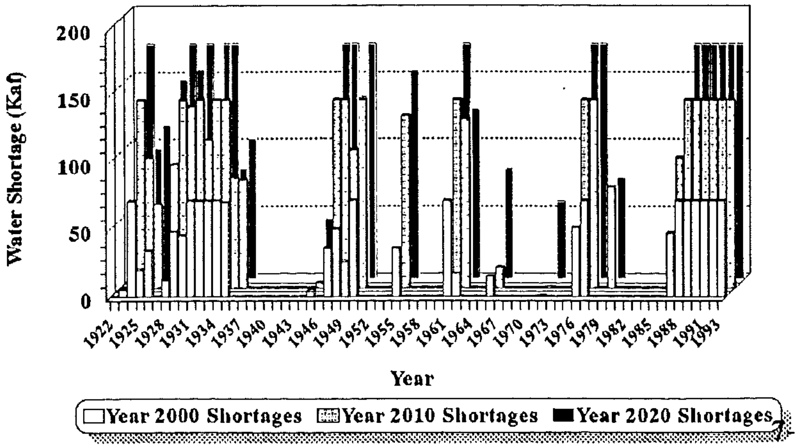


NEAR-TERM WATER SHORTAGES

Thus far, this chapter has focused on water shortages in the year 2020. Without action within the near future, significant water shortages will occur even sooner.

Figure 7.3 shows the occurrence of water shortages based on the 1922 to 1993 hydrology for three different water needs imposed. Years 2000, 2010, and 2020 were the projected water needs investigated and the maximum shortages are estimated to be 71,000, 140,000, and 175,000 acre-feet per year respectively for these water needs.

FIGURE 7.3
Water Shortages at Different Water Demand Levels



The frequency of occurrence, as shown in Figure 7.3 for the water needs of the year 2000, is very similar to that of 2020. Another way to view this is by a cumulative frequency distribution. A cumulative frequency distribution is a plot of the probabilities of water shortages larger than a particular magnitude. Figure 7.4 shows this distribution of the three water needs. As shown by Figure 7.4, the shape of these distribution curves does not change very much as water needs increase in the future; that is, in all of these anticipated water needs, severe shortages can be expected more than 20 percent of the time with the magnitudes increasing from 71,000 to 175,000 acre-feet per year as the water needs increase.

FIGURE 7.4
Cumulative Frequency Distribution of Water Shortages for Different Projected Water Needs

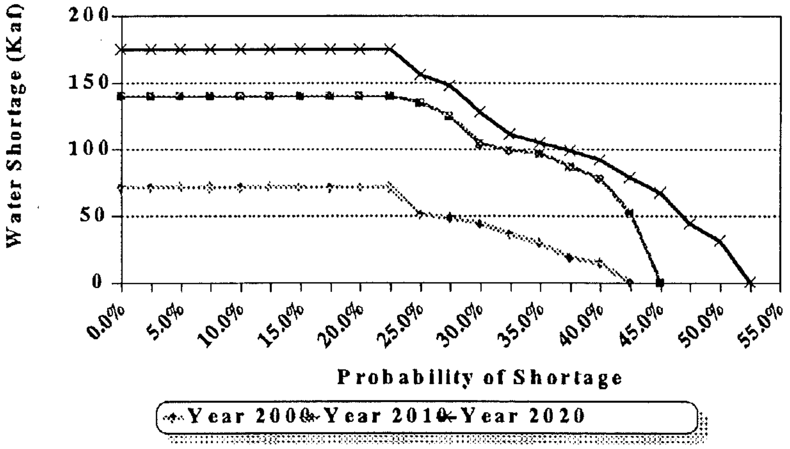


Table 7.5 shows the recorded and projected water supply and needs for the county. While shortages as high as 175,000 acre-feet per year could occur in the year 2020, shortages of more than 100,000 acre-feet per year could occur within 10 years if a critical dry period occurs and no action is taken to alleviate the problem.

TABLE 7.5

Recorded and Projected Water Supply, Demand, and Shortages for the Critical Dry Period in Santa Clara County With the CVP M&I Shortage Policy (thousands of af/year)

Years	1985	1990	1995	2000	2005	2010	2015	2020
Critical Dry Period, Average Water Supply, and Storage Withdrawal	405	350	390.7	390.7	390.7	390.7	390.7	390.7
Critical Dry Period (Hot Weather) Demand	405	350	375	442.7	489.3	505.8	520.8	534.2
Critical Dry Period Average Shortage			0	52	98.6	115.1	130.1	143.5
Maximum Shortages With CVP M&I Policy			0	71	121	140	156	175

SUMMARY

If measures are not taken to develop additional water supplies for Santa Clara County and the most stringent of the proposed standards to regulate deliveries from the Delta are adopted, during a critical dry period the county could suffer a maximum water shortage of 247,000 af/year for year 2020. If the proposed CVP M&I Shortage Policy is adopted, the maximum water shortage during a critical dry period would be 175,000 af/year for year 2020.

Significant water shortages could happen even sooner than the year 2020. The maximum water shortage during a critical dry period for the year 2000 would be 108,500 af/year; if the CVP M&I Shortage Policy is adopted, the maximum shortage would be 71,000 af/year.

The projected water supply and shortages are those which **might** occur during a critical dry period, not what necessarily **will** occur. However, maximum shortages are not rare occurrences. Based on past hydrologic trends, and given the year 2020 demand forecast, the adoption of the EPA standard governing Delta exports, and implementation of the Shortage Policy, the maximum shortage could be expected to occur 25 percent of the time and some form of shortage could be expected 50 percent of the time.

Chapter 8

Demand Side Management

Chapter 8
DEMAND-SIDE MANAGEMENT

This chapter provides a brief overview of potential demand-side management methods, including efficient water use programs, mandatory water use reductions, and land use controls that limit new water demands. It also analyzes the water use reductions expected from each of the District's demand-side programs through year 2020.

BACKGROUND

Like most water agencies in California, the District has recognized the importance of demand-side management in its water resource management efforts. Water agencies have traditionally viewed their role as the providers of sufficient quantity and quality of water to meet community needs. The recent prolonged drought and new state and federal legislation have compelled California's water utilities to broaden their role from water supply management to include the management of water demands, or demand-side management (DSM).

In 1991, the District joined with more than 200 public agencies, advocacy groups, and other interested parties in signing a conservation memorandum of understanding (MOU). To comply with this memorandum, the District will implement a series of 16 best management practices (BMPs) over a 10-year period (1991 to 2001). In October of 1993, the Board adopted a staff proposal to make DSM a permanent component of the District's water supply strategy.

The terms of the MOU require the District to implement those BMPs which demonstrate a positive benefit/cost ratio. The MOU includes a method for calculating this ratio, which has been used by staff to screen the following programs. Staff analysis indicates that all of the BMPs evaluated for the District's DSM program show a positive benefit to cost ratio.

DEMAND-SIDE MANAGEMENT The Urban Water Management Planning Act of 1983 (AB 797) defines DSM as "those best management practices, water conservation measures, programs, and incentives that reasonably minimize the waste of water and promote the efficient use of available supply."

DEMAND-SIDE MANAGEMENT

While all 16 BMPs are effective tools for reducing water demands, some are more promising than others. More importantly, the impacts of some BMPs can be quantified more readily. To ensure the highest level of reliability, included in this analysis are only those BMPs which are thought to result in quantifiable water use reductions.

The following is a review of those BMPs which the District is currently implementing. Impacts from activities such as metering and plumbing code changes have already been accounted for in the water needs forecast in Chapter 4 and are not included here.

Retrofits

- *Plumbing*—The MOU specifies that low-flow showerheads are to be distributed to all pre-1980 homes that do not have them. Prior to 1992, more than 200,000 such devices had been distributed within the county by retail water suppliers and other agencies. Surveys have shown that approximately 78 percent of the homes in Santa Clara County have already installed low-flow showerheads. In June 1992, the District's Board approved a retrofit kit distribution program which will result in the installation of 120,000 kits and reduce demands by an additional 2,500 af/year by the year 2002. To date, 37,000 retrofits have been completed with an estimated water demand reduction of 850 af/year.

- *Ultra-Low-Flush Toilets*—The retrofit of ULFTs should achieve water use reductions of approximately 14,500 af/year. This is to be achieved through the retrofit of approximately 400,000 ULFTs. The District has adopted a goal of 230,000 retrofits through its incentive program with a rebate of $75 per toilet or a potential rebate outlay of $17 million. To date, the District and its retailers have retrofitted approximately 16,000 ULFTs at a cost of $1.2 million. An estimated 1,000 af/year in demand reductions have occurred as a result of these retrofits

Water Audits

- *Residential*—The program will target the top 20 percent of residential water users and encourage 20 percent of this group to accept a comprehensive audit. Implementation of this BMP is expected to reduce residential water demands approximately 2,300 af/year by the year 2002. To date, the District and its retailers have audited more than 4,500 single-family homes and 600 multifamily complexes. These activities are expected to result in demand reductions of approximately 800 af/year.

BEST MANAGEMENT PRACTICES

1. Residential audits
2.a. Plumbing code
b. Legislative support
c. Showerhead retrofit
3. Distribution audits
4. Metering
5. Large landscape audits
6. Landscape ordinance
7. Public information
8. Schools program
9. C/I water conservation
10. Water use review
11. Conservation pricing
12. Residential landscape conservation
13. Waste water prohibitions
14. Water conservation coordinator
15. Financial incentives
16. ULFT retrofit

- *Distribution*—The MOU requires distribution system water audits if unaccounted-for water exceeds 10 percent of total use. The District's system losses are less than 1 percent of total water use. Countywide, unaccounted-for water is approximately 8 percent of total use among all retailers. As a result, water demand reductions have not been developed for this BMP.

- *Large Landscapes*—All landscaped sites of 3 acres or more are to be contacted and offered landscape water audits. Programs are expected to achieve a 15 percent water use reduction among participating sites. Targeted groups include multifamily, commercial, industrial, institutional, and public facilities. To date, District activities have consisted of providing audit training to retail water suppliers and landscape professionals. This approach has resulted in little identifiable demand reduction. Future plans call for more aggressive support for large landscape audits. Assuming a conservative 20 percent participation rate among eligible sites, landscape water use could be reduced approximately 1,500 af/year by the year 2002. However, these same sites are also being targeted by the reclamation projects now being developed. If reclaimed water is used on these sites, then potable water conservation will not result.

CALIFORNIA LANDSCAPE ORDINANCE

In 1990, the Water Conservation in Landscaping Act was adopted by the California State Legislature. The act requires cities and counties to adopt water-efficient landscape ordinances by January 1, 1993. District staff, working closely with local landscape experts, developed a model ordinance which uses a water budget approach. This approach allows the landscape designer maximum flexibility yet yields reliable water use reductions by establishing a water use allocation for the site.

In June of 1992, the District's Board adopted a model ordinance. As a result of the District's aggressive leadership and education efforts, Santa Clara County and nine cities adopted water budget-based ordinances. Together, these agencies represent 80 percent of the population of the county. This places Santa Clara County among the top counties in the state in the area of landscape water efficiency.

Water-Efficient Landscapes

- *Public*—With the implementation of the 1990 state landscape ordinance, water-efficient landscaping in new multifamily, commercial, industrial, institutional, and public facilities will reduce water demands 4,000 af/year by 2002 from the projected water use.

- *Residential*—Landscape water savings of 50 percent are possible for new and existing single-family homes when water-efficient design and maintenance practices are implemented. The District's current activities in this area include distribution of literature, public outreach, seminars and workshops, and support for demonstration gardens. Future plans include awards and incentives programs. Assuming a 5 percent participation rate among existing single-family homes and 20 percent participation among new construction, it is estimated that residential landscape water use can be reduced by 5,000 af/year in the year 2002.

Commercial and Industrial Water Conservation

The top 10 percent of the commercial and industrial water users will be contacted and offered audits and incentives. This should achieve 12 to 15 percent water use reductions among program participants. It is anticipated that 20 to 30 of those contacted will eventually participate in the program. To date, retail water suppliers have performed approximately 90 audits which have reduced demands by an estimated 150 af/year. Future plans call for the District to provide more support for commercial/industrial conservation programs. Based on the types of retrofit projects typically undertaken by industry in Santa Clara County, it is estimated that water demands can be reduced by 2,500 af/year.

Public Information

The District has an aggressive public information program. The program's water conservation activities include distribution of water conservation literature, public outreach activities, speaking to community groups about water conservation, answering public inquiries regarding conservation issues, and participation in special events. The District has also operated a schools program to provide educational materials and instructional assistance to school districts within their service territory. No demand reductions have been estimated for this effort because no generally acceptable savings estimates exist for public outreach and information programs.

Table 8.1 summarizes the water demand reductions under the BMPs.

TABLE 8.1
Demand Reductions Resulting From BMP Implementation

Best Management Practice		Current Savings (af/year)	Anticipated Savings in 2002 (af/year)
Retrofits	Plumbing	850	2,500
	ULFT	1,000	14,500
Water Audits	Residential	800	2,300
	Distribution	0	0
	Large Landscape	0	1,500
Landscape Conservation	Public	*	4,000
	Residential	*	5,000
C/I Water Conservation		150	2,500
	TOTAL	2,800	32,300

* Estimates of current savings are not available.

It should be noted that as the BMP audit programs are terminated after the MOU deadline, some degradation in demand reductions will occur. It is estimated that 3,200 af/year may be lost by 2020.

Potential Best Management Practices

In addition to the 16 BMPs, the MOU contains 11 Potential Best Management Practices. These include demand management tools such as efficiency standards for appliances and irrigation devices, gray water use, distribution system pressure regulation, and point-of-use water heating systems. The Board of Directors has requested staff to pursue these additional conservation measures.

At this time, work is progressing around the state to document the potential benefits associated with these measures. Staff believes that the measures which are most likely to be added to the list of BMPs during the term of the MOU are efficiency standards for horizontal-axis washing machines and promotion of gray water use, which will be discussed in the next chapter.

The horizontal-axis washing machine is an emerging technology that is receiving support from electric utilities. As a result, a number of pilot incentive programs are already in place around the state. It is estimated that water demands could be reduced by 5,200 af/year by 2020. The District, along with other water utilities, are currently participating in a nationwide study of this technology to evaluate the energy and water savings as well as customer acceptance of this machine. But it's unclear whether this technology will be developed and whether the market will accept the new product.

Implementation of Best Management Practices After 2002

After the term of the MOU expires in 2002, the District's DSM programs will pursue those BMPs and potential BMPs which still have potential demand reductions that can be achieved in a cost-effective manner. By then, the most significant progress should have occurred in residential indoor water use. Penetration rates for low-flow showerheads are expected to be near 100 percent and penetration rates for ULFTs should approach 50 percent. The District will pursue water savings opportunities in large landscapes, commercial/industrial facilities, and residential landscapes through the year 2020.

- *Large Landscapes*—The District will complete periodic landscape audits to ensure that irrigation systems continue to perform at their design efficiency. In addition to the savings identified previously, 300 af/year can be expected by 2020. Again, if reclaimed water competes for the same sites, these anticipated water reductions would not be realized from the potable supply; hence, the audits will not help reduce the county's water supply shortfall.

- *Commercial/Industrial*—Substantial efficiency improvements can be expected from the commercial/industrial sector as technologies evolve and small to mid-sized companies implement conservation measures now being used by large corporate facilities. Further gains can also be made as electric, wastewater, and water utilities coordinate their outreach activities. Staff estimates that an additional 3,000 af/year of demand reductions are possible by 2020 in the commercial/industrial sector.

- *Residential*—The District will seek to expand local water-efficient landscape ordinances to include all developer-supplied landscapes in single-family new construction. By including single-family new construction, an additional 6,800 af/year could be saved by year 2020. By continuing retrofit or replacement programs, landscape water use can be reduced by an additional 1,600 af/year.

Table 8.2 summarizes the demand reductions that the potential BMPs could achieve.

TABLE 8.2
Additional BMP Savings Estimates

Best Management Practice		Estimated Savings in 2020 (af/year)
Large Landscape Audits		300
Commercial/Industrial Conservation		3,000
Residential Landscape Conservation	New Construction	6,800
	Retrofit	1,600
	TOTAL	11,700

Agricultural Water Management

In addition to urban water conservation, the District is developing an agricultural water conservation program. This program is required of all CVP contractors under criteria established by the USBR. The agricultural water management program will include low-interest loans for on-farm irrigation efficiency improvements, support for irrigation pump testing, support and training in the use of the California Irrigation Management Information System for irrigation scheduling, and development of mobile irrigation labs. Implementation of these programs is expected to result in a reduction of agricultural water demands of 1,000 af/year by 2020.

Summary of Program Impacts

Table 8.3 summarizes the expected impact of the proposed DSM activities through the year 2020. Total projected reductions are 46,700 af/year. When combined with existing or proposed plumbing code changes, which are addressed in Chapter 4 of this report, the total conservation savings is projected to be 74,700 af/year.

TABLE 8.3
Projected Demand Reductions

		1992	1999	2002	2020
BEST MANAGEMENT PRACTICES					
Retrofits:	Plumbing	1,100	2,300	2,500	2,500
	ULFT		9,900	14,500	14,500
Audits:	Residential	100	1,500	2,300	300
	Large Landscape	0	1,200	1,500	0
Landscape Con:	Public	0	2,100	4,000	6,500
	Residential	0	3,000	5,000	5,000
C/I Conservation		0	1,600	2,500	0
Total BMP Reductions (af/yr)		**1,600**	**21,600**	**32,300**	**28,800**
POTENTIAL BMPs					
Appliance Efficiency Standards		0	0	1,200	5,200
Total Potential BMP Reduction (af/yr)		**0**	**0**	**1,200**	**5,200**
ADDITIONAL BMP SAVINGS					
Large Landscape Audits		0	0	0	300
C/I Conservation		0	0	0	3,000
Res. Landscape (new construction)		0	0	1,600	6,800
Conservation Retrofit		0	0	0	1,600
Total Additional BMP Reductions (af/yr)		**0**	**0**	**1,600**	**11,700**
AGRICULTURAL CONSERVATION					
Mobile Lab		0	100	250	400
Low-Interest Loans		0	200	400	600
Total Ag Reductions (af/yr)		**0**	**300**	**650**	**1,000**
TOTAL PROJECTED REDUCTIONS		**1,600**	**21,900**	**35,750**	**46,700**

SHORT-TERM DEMAND REDUCTIONS

In January of 1992, the Board adopted a Water Supply Shortage Contingency Plan. This plan was developed in response to amendments made in the California Water Code. The District's plan outlines a four-stage implementation effort for addressing short-term water supply shortages. The four stages are a 10 percent voluntary program and three mandatory reduction programs of 25 percent, 35 percent, and 50 percent. To obtain

50 percent mandatory reductions, irrigation of all outside landscaping would most likely be banned.

Impacts of Demand-Side Management Programs on Mandatory Reduction Program

Table 8.4 shows the results of the mandatory conservation efforts implemented during the recent drought. Due to low storage levels in the groundwater basin, voluntary water conservation was requested in 1988 but did not result in a significant reduction in water demands. In 1989, mandatory reductions were requested and were enforced for the following 3 years.

TABLE 8.4
Countywide Water Use Reductions During Drought

Year	Savings Due to Mandatory Reductions From Predrought Use (1987)
1989	19%
1990	19%
1991	28%
1992	21%
Average	22%

As more conservation measures are developed and implemented in the future, short-term demand reductions will become more difficult to implement because of the increased efficiency in overall urban water use. These increases in efficiency mean that current drought contingency measures will be less productive in the future because opportunities to reduce or eliminate water use will no longer exist. This is known as "demand hardening."

One concern about mandatory reductions involves the distribution of conservation hardship. At the county's 13 largest high-tech water-consuming facilities, 75 percent of the water use is for manufacturing, 5 percent for cooling, 14 percent for personal use, and 6 percent for landscape irrigation. Requiring these businesses to further reduce their consumption beyond current water conservation measures and nonpotable reclamation could subject them to process curtailments and significant financial hardships. Correspondingly, the less the mandatory use reductions are shared by the commercial/industrial sector, the greater the burden on the county's residential customers. During the 1987 to 1992 drought, most of the burden of conservation fell on residential customers.

Staff has estimated that if the same level of mandatory reductions imposed during the recent drought were to be implemented during a future drought, they would result in only a 10 percent savings on total water demands. This is because BMPs and potential BMPs and nonpotable reclamation limit the opportunities for additional water savings. Figure 8.1 illustrates the relationship between hardened demand and mandatory reductions.

FIGURE 8.1
Relationship Between Hardened Demand and Drought Contingency Measures

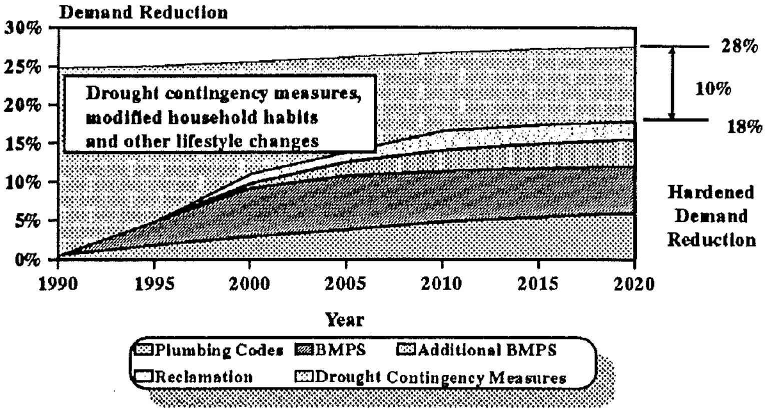


Figure 8.1

A recent study analyzed the issue of demand hardening and concluded that while hardening is real—the same gallon of water cannot be saved twice—implementation of DSM programs can have several important positive impacts on short-term demand reduction programs. Because customer awareness of water use increases, customers can reduce their water use without significantly disrupting their normal lifestyle and/or business operation. DSM also makes for good public relations for the water agency: when an agency is visibly proactive in solving water supply problems, its customers are more willing to reduce water use during shortages. Lastly, a water agency's experience in implementing long-term conservation programs allows it to more quickly and effectively implement short-term demand reduction programs when necessary.

LAND USE CONTROLS

The District is not empowered to control land uses. Only the local cities and the county have this authority through their general plans. Legislation recently introduced in the State Assembly (AB2673) recognizes the diminishing water supplies of the state and acknowledges that water agencies may have a difficult time meeting their future commitments. The bill states that any general planning by cities or counties for growth outside of existing water agency service areas must be conditioned upon water agency findings of either adequate existing water supplies, or firm future supplies to meet existing or future customers' water needs through periods of drought.

The policy of the District is to meet all water needs of the county and not to preclude development from occurring. Hence, land use controls are **not** a management option that the District is going to pursue in the future to balance water needs and water supplies.

SUMMARY

Demand-side management includes efficient water use programs (long-term reductions), short-term demand reductions, and land use controls that limit new water demands. The District is conducting an aggressive long-term water use reduction program. This program includes the BMPs of retrofits of showerheads and low-flow toilets, outdoor water audits, and commercial and industrial indoor audits. This program has been authorized by the District's Board of Directors to continue into the future. These efficient water use programs will also serve to ''harden water demand'' thereby diminishing a water user's ability to comply with short-term water use reductions. The same level of hardship that has been imposed upon the county during the last drought is anticipated to only yield a 10 percent short-term water reduction in the future. Finally, the policy of the District is to meet all water needs of the county and not to preclude development from occurring through land use controls.

Chapter 9

New Sources of Supply

Chapter 9
NEW SOURCES OF SUPPLY

This chapter describes the various new sources of supply that can be used to meet the water supply shortage of the county. These options include nonpotable and potable water reclamation, water transfers, the State Water Bank, desalination, gray water, and additional local supplies. The chapter provides a detailed assessment of the technical, political, and financial issues associated with each option.

COUNTYWIDE RECLAMATION POTENTIAL

Reclaimed water has been recognized as a valuable source of water supply in the county. As a supplemental water supply, reclaimed water is drought-resistant and is independent of future decisions regarding the Delta water right reallocation. Wastewater treatment plants have demonstrated that they can produce a reliable effluent quality that meets Title 22 health requirements and is suitable for landscape and agriculture crop irrigation and some industrial process uses. The use of reclaimed water in the county could also enhance the water quality in the Bay by reducing the current metal loading to the Bay.

A summary of countywide reclamation projects in Table 9.1 shows that approximately 46,500 af/year of reclaimed water could be developed and delivered throughout the county. Of this quantity, 41,500 af/year of reclaimed water could supplement the District's water supply. The average cost of nonpotable reclaimed water is estimated at $990 per af; this does not include the user's site modification, land easements, and right of way acquisition costs.

WATER RECLAMATION

The District and several local agencies in Santa Clara County are investigating two types of reclamation and reuse projects that can supplement water supplies: nonpotable water reclamation and the surface storage and groundwater recharge of reclaimed water for a potable supply. These two types of projects have very different implementation issues, schedules for implementation, and project costs. The export of nonpotable reclaimed water to the Central Valley in exchange for other raw water supplies is also being investigated and is described.

Nonpotable Water Reclamation

Reclaimed water has been used in California since the 1890s. A 1987 survey found that 300,000 af/year of reclaimed water was used in California. Of this quantity, approximately 70 percent was used for irrigating landscape plants and agricultural crops. About 2,000 af/year of reclaimed water is currently being used for landscape irrigation in Santa Clara County.

In July 1993, the District's Board adopted a nonpotable reclamation policy which provides for the District's financial participation in nonpotable reclamation projects in the county. The District will provide financial assistance of $93 per acre-foot of nonpotable reclaimed water produced to encourage the development of reclamation. Such water must, however, supplement the county's water supply and replace firm water demands that are presently met or would be met in the future by supplies from the District.

Several reclamation projects have been investigated by either local agencies and/or the District:

- *San Jose/Santa Clara Reclamation Project*—The San Jose/Santa Clara Water Pollution Control Plant (SJ/SC WPCP) is a jointly-owned regional wastewater treatment plant with a design flow capacity of 167 mgd. The plant effluent is tertiary treated to high-quality standards, and may be reused for industrial process and agricultural and landscape irrigations.

  In November 1990, the District's Board approved a cost-sharing agreement with the City of San Jose for investigating the potential reuse of treated effluent from the SJ/SC WPCP in the Golden Triangle. Three project alternatives were developed, and the project, which had the potential to extend beyond the Golden Triangle, was selected and approved by the San Jose City Council, contingent upon environmental review and the acceptance of the South Bay Action Plan.

RECLAMATION AND HABITAT PROTECTION
In 1989, the United States EPA and the Regional Water Quality Control Board (RWQCB) determined that the fresh water discharged from the SJ/SC WPCP has reduced the salinity of nearby salt marshes, converting them to fresh water marsh and threatening the habitat of two endangered species (the salt marsh harvest mouse and the California clapper rail). Subsequently, United States EPA and RWQCB enforced orders to prevent further marsh conversion. To fulfill the requirements, the City of San Jose has developed a South Bay Action Plan to limit discharge flow from the SJ/SC WPCP to 120 mgd. One of the elements of this Action Plan is to reclaim treated plant effluent for nonpotable uses.

The City of San Jose has conducted a study for the expanded area and has reassessed the market for nonpotable reclaimed water. The study has shown that approximately 9,000 af/year, or 16 mgd of reclaimed water could be delivered to the Golden Triangle beginning in 1997. Additional demands of 28,000 af/year or 50 mgd in the Greater San Jose area have been identified and could be delivered in the future. Most of this water would displace District supplies. The average cost of nonpotable reclaimed water is estimated at $1,110 per af from the San Jose/Santa Clara reclamation projects.

- *Sunnyvale Reclamation Project*—The Sunnyvale Water Pollution Control Plant (WPCP) has a design flow capacity of 29 mgd for the treatment of wastewater from the City of Sunnyvale with predrought inflows of 17 mgd. The current discharge flow from the plant is approximately 14 mgd due to the current drought-related water conservation measures. A wastewater reclamation program developed in 1991 identified a short-term goal of recycling 20 to 30 percent of the high-quality tertiary effluent within the next 3 years. A long-term goal of this program is to reuse 100 percent of the effluent generated from the plant.

  The city has started a major capital improvement program to implement the short-term goal of this program. Approximately 1 mgd of reclaimed water is scheduled to be delivered to the Bayland Park and nearby sites in 1994. An additional 1.2 mgd will be delivered to serve the demands north of Highway 237 in 1995. This reclaimed water could displace either Hetch Hetchy supplies or District supplies. The cost of reclaimed water produced from the Sunnyvale WPCP for these projects is estimated at $610 per af.

HURDLES TO OVERCOME
Several hurdles must be faced by the project sponsors if the maximum possible nonpotable reclaimed water is to be achieved in the county. These include the development of the reclaimed water market, public safety/health issues, and the suitability of reclaimed water for native plants. These hurdles could be overcome through public outreach and education programs and a careful reclaimed water management program.

- *Gilroy Reclamation Project*—The existing Gilroy/Morgan Hill Wastewater Treatment Facility provides wastewater treatment for the Cities of Gilroy and Morgan Hill with a current capacity of 6.1 mgd. A long-term plan was developed in 1984 and outlined the phased implementation of wastewater and disposal facilities for the next 20 years. The long-term plan proposed a new 7.5 mgd secondary wastewater treatment facility. Construction of this facility is scheduled to be completed in 1994. About 3 mgd of the secondary effluent will undergo tertiary treatment at a new reclamation facility to meet the higher standards for reuse required for landscape and agricultural crop irrigation, and some industrial processes. The reclamation facility is proposed to be expanded to 12 mgd by the year 2018.

Currently, 100 af/year of reclaimed water is being used in the Gilroy area. An additional 2,250 af/year of reclaimed water is proposed to be delivered by 1995—all of which would displace District supplies. The cost of reclaimed water is estimated at $240 per af for treatment; this cost is low because the project will use a distribution system constructed by the District.

- *Palo Alto Reclamation Project*—The Palo Alto Regional Water Quality Control Plant provides wastewater treatment and disposal capacity of 38 mgd for the Cities of Palo Alto, Mountain View, Los Altos, and Los Altos Hills. In April 1992, a *Water Reclamation Master Plan* was completed. Two purposes of pursuing a reclamation project were identified in this plan: to provide additional water supply to the water utilities in the study area and to reduce the wastewater constituent mass metal loadings discharged to the South Bay from the plant.

  Approximately 2,300 af/year of reclaimed water is scheduled to be delivered to the Palo Alto Municipal Golf Course and nearby sites by 1994. An additional 1,400 af/year of reclaimed water is anticipated to be delivered by 1997. A total of 4,700 af/year of reclaimed water is planned to supplement the existing potable water supply from the San Francisco Hetch Hetchy Water System. The estimated cost of reclaimed water developed by the Palo Alto Regional Plant is $660 per af. This reclaimed water would not displace District water but would only displace water from the Hetch Hetchy system.

TABLE 9.1
Santa Clara County Nonpotable Reclamation Projects

Reclamation Projects	Estimated Yield (af/yr)	Estimated Capital Cost ($)	Estimated Reclaimed Water Cost ($/af)
San Jose/Santa Clara Water Pollution Control Plant	37,000	416,700,000	1,110
Sunnyvale Water Pollution Control Plant	2,460	14,500,000	610
Gilroy/Morgan Hill Wastewater Treatment Plant	2,350	4,600,000	240
Palo Alto Regional Water Quality Control Plant	4,720	30,000,000	660
TOTAL	46,530	465,800,000	990

RECHARGE: POTENTIAL EFFECTS ON GROUNDWATER BASIN

The Santa Clara Valley subbasin in the North County is a critical component of the District's system. It has an effective storage capacity of 250,000 af. The natural groundwater recharge into the basin averages 60,000 af/year and the average artificial recharge accounts for another 98,000 af/year. Any degradation of the subbasin resulting from groundwater recharge of reclaimed water could require well head treatment at substantial cost to the water retailer or the potential loss of a portion of the basin. Another potential degradation of the groundwater basin could result from the reduced transmissivity of the basin due to the quality of the recharge water.

Groundwater Recharge Using Reclaimed Water

Recharging the underlying groundwater aquifers with reclaimed water is a potential source of supply for the county that is independent of the hydrological conditions of the valley. In a joint study with the City of San Jose, the District has determined that up to 25,000 af/year of reclaimed water could be developed for groundwater recharge under the criteria being proposed by the State DHS.

At the present time, DHS allows only indirect reuse (i.e., groundwater recharge) of reclaimed water for a potable drinking water supply. Currently, the California Office of Drinking Water is developing guidelines for planned projects to recharge reclaimed water into groundwater basins which allows two principal methods for groundwater recharge: surface recharge through percolation, and direct injection.

WateReuse, through the Potable Reuse Regulatory Subcommittee, has drafted and submitted to state agencies a proposal to use a surface reservoir as the blend facility for potable reclaimed water. The reclaimed water would have to meet the same stringent water quality requirements as for groundwater recharge and in addition would also have to reduce the nutrients in the water that could cause algal growth in the reservoir. From this reservoir, water could be withdrawn and recharged or transferred through pipelines and used at a conventional water treatment plant. This new mode of operation complements the District's system and does not compete with limited recharge facilities. District staff has investigated this mode of operation with the Utility's simulation model and has determined that 60,000 af/year of potable reclaimed water could be utilized in the system. State Health will still need to approve of the concept of using a surface reservoir for blending reclaimed water before any future project can be undertaken.

The major concerns for recharging reclaimed water into the groundwater aquifer are: (1) health effects considerations and the possibility of degrading the groundwater basins, (2) public acceptance, (3) existing system limitations to recharge an additional source of water, (4) future water quality standards that are more restrictive, and (5) high project costs. These are discussed in detail below.

- *Water Quality and Health Effects*—There are three major health effects regarding drinking water: acute health effects that are severe and occur over a short duration; microbiological contamination from bacteria, viruses, and protozoans; and the chronic or long-term health effects that can cause cancer or reproductive defects.

  Acute toxicity by its very nature is very well defined and treatment processes and testing protocols are available to ensure that acute toxicity of any water source can be avoided. Heavy metals (such as arsenic, mercury, and silver) are acutely toxic to humans.

Microbiological contamination can be caused by bacteria, viruses, or protozoans. The major diseases caused by bacteria are typhoid, cholera, tuberculosis, and dysentery. Viruses are known to cause polio, meningitis, hepatitis, and gastroenteritis. Two new protozoans have recently been regulated; these can cause such severe cases of gastroenteritis that several deaths have occurred. All of these microbiological contaminants have been investigated and barrier approaches of processes and disinfection have been identified to deal with all of these contaminants.

Organic contamination results from three major sources: the breakdown of naturally occurring organic materials, domestic and commercial disposal, and reactions that occur during treatment and transmission. The first types of organics generally predominates in water sources but are generally benign (although some cause taste and odor problems). The second, commercial and domestic wastewater discharges, are responsible for the major health effects concerns. Some of these compounds are pesticides, solvents, degreasers, and plasticizers, which may create long-term or chronic health effects such as cancer or reproductive defects. The third source of organics, which are formed during treatment, are currently under intense investigation. TOC is an overall measure of organic contamination. Potable waters being supplied from the District's treatment plants have a TOC of 3 to 4 ppm. The effluent from the SJ/SC WPCP has an average TOC of 11 ppm and a maximum TOC of 16 ppm. The fraction that can be identified as to the specific type of organic is less than 5 percent. Hence, the vast majority of the organics in wastewater are of unknown nature, and the health effects for many of these compounds have not been determined. Added to this concern is the mandate to EPA to regulate 25 new compounds every 3 years. The vast majority of these newly-regulated compounds are organics that create long-term health effects. The water quality standards proposed by State Health reflect these concerns.

Four major health effects studies have been performed on water reclamation projects in the United States. The first study was completed in 1984 by the Los Angeles County Sanitation Districts at a cost of $1.6 million. The project concluded that there were no adverse health effects but it did not evaluate long-term health effects. Three other studies have been recently completed for Denver, Tampa, and San Diego. The Denver study included animal testing and 5 years of operation and had the only long-term health effects work. Denver's work showed no adverse health impacts from the high quality of water produced from their 1 mgd demonstration plant.

- *System Limitations*—The wastewater treatment plants that would provide reclaimed water for groundwater recharge are located along San Francisco Bay. A regional aquitard exists near the Bay, creating a confined zone where surface water cannot percolate nor can it be recharged by an injection well into the deeper potable water aquifer. Outside of this zone is the forebay, where surface water can percolate into the potable aquifer.

  There are two principal methods for groundwater recharge: surface recharge and direct injection. Surface recharge with reclaimed water was investigated with the District's existing percolation system. Studies showed that reclaimed water competes with the District's other sources of water for the existing available recharge capacity. During very wet periods (such as the water years 1982 and 1983 when rainfall was nearly twice the average), the recharge capacity of all of the percolation ponds are used by local water. If local water is not prioritized, then it will spill to the Bay, possibly creating flooding problems. During very dry years (such as if 1977 were repeated in the future when rainfall was 60 percent of normal and the imported water delivered would be less than 10 percent of entitlement), very little raw water would be available for blending to meet DOHS requirements. In most locations where recharge is feasible, the minimum depth to groundwater required by DOHS cannot be met. Hence, a continuous annual discharge from the SJ/SC WPCP, regardless of local hydrology, cannot be recharged by surface spreading without a storage reservoir.

  Direct injection was investigated at two locations: one near the SJ/SC WPCP and the other in the Santa Clara Valley Subbasins forebay zone. An injection well field near the WPCP was found to be unfeasible because the confined zone is under such pressure that the injection water cannot be recharged at the rates required. Direct injection of reclaimed water in the forebay zone appears hydraulically feasible. However, additional studies are needed to determine if it is feasible to inject 25,000 af/year continuously under average to wet hydrologic conditions, because of high groundwater levels in the area.

- *Public Acceptance*—Whether the public will accept the use of reclaimed water for groundwater recharge is difficult to predict. Water quality is a very sensitive and volatile issue in the Santa Clara Valley due to the numerous solvent leaks that have occurred here. The recent plan to reuse groundwater contaminated at the IBM site by treating it to drinking water quality and either recharging it or injecting it into the Snell pipeline met with public resistance when it was proposed. This issue must be explored further and may be resolved with very intensive public education.

- *Project Costs*—The alternative which has a zero brine discharge to the Bay would have an estimated total annual cost of $57,300,000 per year (in 1992 dollars) for both capital repayment and operations and maintenance. The average unit water cost for the direct injection of reclaimed water into the groundwater aquifer is approximately $2,700 per af with 25,000 af of water being developed every year. The capital cost is estimated to be $230 million with an annual operation and maintenance cost of $36 million.

Bay Area/San Joaquin Valley Water Reclamation Export Project

A joint powers agreement consisting of Bay wastewater dischargers and wholesale water suppliers is financing a study to determine the feasibility of exporting reclaimed water from the Bay Area to the San Joaquin Valley for agricultural water use. The alternative involves the blending of reclaimed water with Delta water currently being conveyed in the CVP's Delta-Mendota Canal. This would provide high-quality reclaimed water for agricultural irrigation in the northern and central San Joaquin Valley and yield raw water through an exchange agreement for ultimate use as a potable supply.

The major issues to be further explored regarding urban use and for the environment are: (1) the market for this water and the exchange agreement for potable supplies; (2) the expected quality of this water and the treatment upgrades required; (3) the storage requirements and the method of storage (e.g., aboveground reservoir, below ground aquifer, etc.); (4) estimated project costs, assignment of benefits to various agencies, and project cost allocation; and (5) impacts on the San Joaquin groundwater quality and potential degradation to existing potable supplies.

WATER TRANSFERS

The recent prolonged drought in California has prompted renewed interest in the concept of water marketing, which can be defined as the voluntary transfer, lease, or sale of water or water rights. Water marketing was endorsed in 1992 by Governor Wilson in his State Water Policy as a necessary means of stretching California's supply of developed water to meet future water needs. Yet, despite general consensus that some form of water marketing must be facilitated, there is considerable debate about how this activity should be carried out.

EVALUATING TRANSFER POSSIBILITIES

In evaluating water transfer proposals, costs, risk, reliability, environmental constraints, protection of groundwater aquifers, third-party impacts, water rights, and the ability to convey the water must all be considered. Both short-term and long-term transfers through the Sacramento-San Joaquin Bay Delta Estuary are subject to great uncertainty with respect to environmental requirements and costs. The District should focus on transfer agreements from sources located in the Delta export area. The District is in the unique position of being a contractor with both the SWP and the CVP. To take advantage of the District's access to SWP and CVP conveyance and power, and to avoid the need for SWRCB approval, the District should pursue transfer opportunities within the two projects. Long-term transfers are subject to the risk of future legal constraints to protect groundwater resources, the environment, and other water users or water rights holders. Reliability and risks must be thoroughly evaluated, and addressed in the terms and conditions of agreements.

The major unresolved issues surrounding water marketing involve environmental and third-party impacts, protection of water rights, the role of state government, the role of water districts, and the need for additional water storage and conveyance facilities. Rules for water transfers are contained in proposed state and federal legislation, and in the interim policies of the U.S. Bureau of Reclamation and other government agencies. The ultimate form of these legislative and administrative rules governing water transfers will have a significant effect on the extent to which this alternative becomes a part of the District's imported water supplies. The purpose of this section is to examine the opportunities and feasibility of using short-term and long-term water transfers to supplement the District's water needs during future critical dry periods. Sources of transfer water are the CVP, the SWP, or independent water right holders.

Central Valley Project

In October 1992, federal legislation (Title 34, P.L. 102-575) was enacted which greatly increased the ability of CVP contractors to transfer their allocations of CVP water. This legislation, called the Central Valley Project Improvement Act (CVPIA), authorizes water transfers from "all individuals or districts" receiving CVP water "to any other California water use or agency . . . for project purposes or any purpose recognized as beneficial under applicable State law." Prior to this legislation, CVP contractors were prohibited from transferring water between project purposes (e.g., from irrigation to M&I) and from transferring water to individuals or districts outside the CVP service area.

In March 1993, the Bureau of Reclamation completed interim guidelines for water transfers. All transfers require review and approval by the contracting officer. All long-term transfers are subject to continuing annual review and may be "conditioned, temporarily suspended, or terminated" if the contracting officer determines that there are any adverse impacts to CVP operations or the environment.

Among CVP contractors, those with the most reliable source of transfer water are the San Joaquin River Water Rights Exchange Contractors, which include the San Luis Canal Company, the Columbia Canal Company, the Firebaugh Canal Water District, and the Central California Irrigation District. The Exchange Contractors have a unique and perpetual contract with the Bureau of Reclamation for the delivery of 840,000 af of CVP water from the Delta-Mendota Canal in place of water that would have otherwise been taken by the Exchange Contractors from the San Joaquin River under riparian and pre-1914 appropriative water rights. The contract provides that, based only on the inflow to Shasta Reservoir, this CVP supply may be reduced by no more than 25 percent. Such shortages have occurred only three times within the last 42 years. Prior to enactment of the CVPIA, districts or individuals receiving CVP water under the Exchange Contract could not transfer this water.

Another reliable source of transfer water within the CVP is the Sacramento River Water Rights Contractors. Like the Exchange Contractors, these contractors receive CVP water in place of water that would otherwise be taken from the Sacramento River under riparian water rights, and their CVP supply is subject to shortages of no more than 25 percent based only on the inflow to Shasta Reservoir. However, the Sacramento River Water Rights Contractors' settlement contract is not perpetual, and will expire in the year 2016. The Bureau will probably seek to revise the shortage criteria at that time. Also, any transfer water obtained from sources that are tributary to the Sacramento-San Joaquin Bay Delta Estuary will be subject to significant environmental requirements, including dedication of a portion of the transfer water for fish and wildlife purposes.

Other sources of transfer water within the CVP are primarily irrigation contractors. CVP irrigation water, whether upstream or downstream of the Delta, is subject to significant shortages. Even if irrigation water is transferred for M&I use, it will always retain the relatively low reliability of its original purpose.

State Water Project Transfers

Although a number of SWP contractors have transferred water in short-term agreements, the DWR has approved such transfers on a case-by-case basis. There are no formal policy guidelines addressing transfers of SWP water, except for a general "golden rule" that transfers by one State Water Contractor cannot harm the water supply or financial conditions of other nonparticipating State Water Contractors.

During the most recent drought, agricultural contractors suffered severe shortages in supply, which made it difficult for them to cover the fixed costs associated with their SWP entitlement. A number of SWP contractors sought to sell a portion of their SWP entitlement. There was one case in which a SWP contractor (Castaic Lake Water Agency) purchased the entire SWP entitlement and lands of another contractor (Devil's Den Water District). The environmental impacts of this transfer were unique in that no permanent crops were grown in the Devil's Den service area, and no underlying usable groundwater basin was recharged by irrigation runoff. As a result of the agricultural contractors' drought-related financial problems, the DWR and the State Water Contractors began to consider a number of alternatives, including rules for transfer of entitlement, methods of short-term water marketing among SWP contractors, and proposals to modify the SWP agricultural and M&I water shortage criteria. In addition, the recent drought prompted the DWR and various SWP contractors to establish a Water Purchase Committee that will, through the DWR, buy transfer water on behalf of SWP contractors.

DWR is currently completing the environmental requirements for future water purchases and working with SWP contractors to draft an appropriate contract amendment that will allow for cost recovery of water purchases over a 3- to 5-year period. Both of these efforts are expected to be completed by January 1995. In the meantime, DWR and the SWP contractors are proposing a 1-year agreement to purchase water for use in 1994. Such a 1-year water purchase agreement requires less environmental documentation and would serve as a pilot program for future longer term purchases by the Water Purchase Committee. On March 28, 1994, the District's Board of Directors approved participation in this 1994 Water Purchase Committee.

HOW WATER TRANSFERS HAPPEN
Water that is not derived at the expense of any other lawful water user may be made available for transfer through one of six methods:

- ***Fallowing (not irrigating) crops***
- ***Shifting to lower water-using crops***
- ***Substituting groundwater for surface irrigation supplies***
- ***Directly delivering of groundwater***
- ***Conserving water***
- ***Releasing water from reservoir storage***

Independent Transfers

These transfers involve the purchase of water from agencies or individuals who divert water under their own appropriative water rights, independent of the CVP and the SWP. Appropriative water rights are granted by the SWRCB to agencies or individuals who have demonstrated that they have the ability to divert a supply of water and put it to beneficial use, and that this supply is a quantity in excess of that needed by riparian right holders and preexisting appropriative right holders. The California Water Code allows appropriative water rights holders to transfer their water to another water user without fear of forfeiture if statutory procedures which govern approval of transfers are followed. However, many water rights holders are reluctant to enter into long-term transfer agreements or to enter into short-term agreements for 5 or more consecutive years.

In 1989, the District purchased from Yuba County Water Agency 90,000 af of water, which was subsequently stored in San Luis Reservoir and used to alleviate the impacts of the recent drought. In 1991, the District purchased and transferred about 17,000 af of water from Placer County Water Agency. Due to carriage water losses through the Delta, the amounts of Yuba County and Placer County water delivered to the District were 69,000 af and 14,000 af, respectively. All of the water was delivered to Santa Clara County through SWP facilities. The cost of Yuba County water was $45 per af, and for Placer County, $100 per af. After losses and conveyance costs were included, the total costs to the District were approximately $105 per af for Yuba County water, and $179 per af for Placer County water.

STATE DROUGHT WATER BANK

In February 1991, as the State entered its fifth year of drought, Governor Wilson established the Drought Action Team. One of the recommendations of this team was to create an emergency Drought Water Bank which would facilitate the purchase and transfer of water from areas of the state with excess supply to those areas in need of additional supply. DWR was responsible for operating the Drought Water Bank.

During 1991, the Drought Water Bank purchased a total of 820,805 af through 351 contracts for $125 per af. About 51 percent of water bank supplies came from fallowing farmland, 32 percent from groundwater, and 17 percent from stored water. About 400,000 af was sold to cities and water districts, and 270,000 af was stored in Lake Oroville for the following year. Most of the remaining 160,000 af was used to maintain Delta salinity standards. The District purchased 19,750 af from the Bank for $175 per af at the Tracy Pumping Plant. Additional conveyance costs were $50 per af, for a total cost of $225 per af.

In March 1992, Governor Wilson announced the continuation of the Drought Water Bank, and over 143,000 af of water was purchased for $50 per af. The District did not participate in the 1992 State Drought Water Bank.

The 1991 and 1992 State Drought Water Banks demonstrated the effectiveness of transfers to meet short-term water needs, and it is likely that a modified form of the Drought Water Bank will continue in the future as a mechanism to facilitate short-term transfers during drought years. One important impact that the State Drought Water Bank had on the short-term transfer market was that it stabilized the price of transfer water. For future State Drought Water Banks, it is likely that DWR will have to complete additional environmental documentation, since concern over the potential for cumulative impacts of short-term transfers was expressed.

Although the State Drought Water Bank represents an important option for the District in a critically dry year, there is a risk that the District will not be able to obtain all the water it needs from the bank. The highest priority of the bank is to provide water for ''extreme critical needs,'' which include ''domestic use, health, sanitation, and fire protection.'' After extreme critical needs are met, water is allocated through a ''levelling'' process to meet the remaining needs of agricultural and M&I water users. M&I participants must be able to show that they are making maximum use of available water supplies, have total water supplies of less than normal demand, and have a voluntary or mandatory water rationing program in effect.

In addition to the risk that the District's purchases may be restricted by the critical needs of other banking participants, there is also the risk that the State Drought Water Bank may not be in existence during a year in which the District needs to buy water. The bank may not be operated if statewide hydrologic conditions are "normal," and yet, if local conditions are dry or the District wants to rebuild groundwater storage, these may be years in which the District still wants to supplement its imported water supplies.

DESALINATION

The desalination of brackish water and seawater has been practiced for at least 400 years, with the earliest process being distillation. Seawater from the Pacific Ocean off the California coast has a total dissolved solids (TDS) of 34,000 mg/l. To desalinate this water to an acceptable level for drinking water, the TDS must be lowered to 500 mg/l or less. Because of the tremendous amount of thermal and electrical energy required for the process, desalination for municipal drinking water supply has not been used in California until recently. During the recent drought, a number of California water agencies began exploring the desalination to meet their potable water demands. A desalination plant produces 40 percent of the City of Morro Bay's drinking water, and the United States' largest reverse osmosis (RO) seawater desalination plant in Santa Barbara can produce one-third (7,500 af/year) of the city's water needs. Metropolitan Water District recently participated in a $600,000 pilot plant study to evaluate the feasibility of a seawater desalination facility capable of producing 100 mgd and 500 megawatts of power generation along the Pacific Coast near Tijuana, Mexico.

Desalination Processes

Distillation, membrane, and ion exchange are the three major processes for turning seawater into drinking water. Due to the high cost (above $4,000 per af) of an ion exchange process for desalting source water with TDS higher than 1,000 mg/l, only distillation and membrane processes will be discussed in the following sections. All of the processes are energy intensive with the majority of the annual costs going to the energy required for the process, which itself is a major environmental consideration. The greatest impediment to developing a practical technology to desalinate seawater has been this tremendous energy requirement.

- *Distillation Processes*—Distillation combines evaporation and condensation. Feed water is initially heated to boiling and the vapor generated is condensed, producing drinking water. Distillation is generally a side benefit from heat recovery and/or electrical power generation plants. The cost to desalinate seawater by distillation is approximately $3,000 per af.

  Distillation can process relatively high levels of suspended solids in the feed water and produce very high-quality water with TDS less than 25 mg/l. Chemical addition may be required for scale prevention due to the precipitation of feed water mineral salts. Generally the volatile organic compounds in the feed water will evaporate and be found in the product water.

- *Membrane Processes*—Electrodialysis Reversal (EDR) and RO are commonly used for desalination. The difference between these two processes is that EDR is an electrical charge-driven process, and RO is a pressure-driven process.

  Electrodialysis (ED), the precursor of EDR, applies an electrical potential to remove ions in feed water. When electrodes are connected to a source of electrical power, electric current is generated through water by ions migrating to the electrode with an opposite charge. Two types of membranes are used in an EDR process; cation-selective and anion-selective membranes. These two membranes are arranged alternately with a spacer sheet in between that allows water to flow along the face of the membranes. The EDR process does not remove viruses, bacteria, giardia, THM precursors, and other organic compounds. The cost to desalinate seawater by the EDR process ranges from $2,000 per af to $3,000 per af.

  Depending on the type of membrane, the feed water TDS and temperature, and other factors, the pressure required to recover seawater by the RO process ranges from 800 to 1,200 psi. Part of this pressure is needed to overcome osmotic pressure and force water through the membranes from the more saline to less saline side. Single-pass and double-pass RO are the two most commonly used designs. Typical product water quality for a single-pass and double-pass RO are 500 mg/l and 200 mg/l, respectively. The RO process is less tolerant of suspended solids than the EDR and distillation processes. Hence, the RO process requires an extensive pretreatment of its feed water to prevent membrane clogging or biological fouling. The RO process, however, is able to remove viruses, bacteria, giardia, and organic compounds. The cost to desalinate seawater by RO ranges from $1,800 per af to $2,700 per af. Additional costs for product water distribution and waste disposal have not been included in any of these costs.

GRAY WATER

Gray water is the untreated wastewater from various household sources such as showers, bath tubs, bathroom sinks, and washing machines. These water sources, if properly used, can be reused for residential landscape irrigation. Gray water does not include wastewater from toilets, dishwashers, garbage disposal, kitchen sinks, and utility sinks which may contain disease-causing organisms or oil and grease. Water from washing machines if used for soiled diapers is also an unacceptable source of gray water.

Gray water has not been used in California until recently. During the recent drought, a number of water agencies in California have begun exploring the application of gray water to reduce their potable water needs. The City and County of Santa Barbara have allowed the use of gray water, with a permit, in residential and commercial areas since 1989. Other counties in California currently permitting various gray water systems are Calaveras, Los Angeles, San Bernardino, and San Diego. In August 1991, the City of Los Angeles conducted a pilot study to evaluate health effects and horticultural effects associated with the use of gray water by city residents. The study found no disease-causing organisms but did find an increase of total coliform, sodium, and sodium adsorption ratio in soil irrigated with gray water.

Gray Water System

Gray water is collected in a storage tank, then pumped to the landscape distribution system. Excess water from the system will be discharged through the normal sewage system. Gray water is generally used below the surface of the soil in a buried drip irrigation system. Spray and sprinkler irrigation that could directly expose humans is not allowed.

PLUMBING CODE
In March 1994, the California Building Standards Commission approved gray water standards to be incorporated in the California Plumbing Code.

It is estimated that 160 gpd of gray water could be collected from a three-bedroom single-family dwelling with four occupants. Based on this flow capacity, the cost of a gray water system ranges from $800 to $5,000 depending upon the system complexity and capability. These costs do not include modifications of the existing in-house plumbing system and the irrigation system. Gray water could potentially save 30 to 40 percent of the water used in a household. However, it is uncertain whether a large number of households in the county will install such systems because of the maintenance requirements, the cost for the modification of the existing plumbing system and irrigation system, and the complications of permitting and operating.

Health Risks Associated With Gray Water Use

Using gray water does impose some potential risks of transmission of disease-causing organisms, soil/groundwater contamination, and cross connection of gray water to the potable water supply. These risks can be minimized with proper system design and maintenance.

PROS AND CONS OF DEVELOPING LOCAL SUPPLIES

There are both positive and negative aspects to the development of additional local yield as a supply-side management alternative. On the plus side, local yield is not subject to cutbacks based upon Delta water quality regulations. The water is locally available and does not have to be transferred or purchased from other entities. On the down side, however, is the fact that during a critical dry period, when additional water supplies are most needed, virtually all of the county's local supply is already developed into local yield. Thus, new facilities will not provide additional local yield during a future drought. Also, there are challenges to construct additional local reservoir storage and percolation ponds in the valley. It may not be feasible to raise local dams due to environmental and engineering considerations. And with undeveloped land in the North County at a premium, obtaining a suitable recharge site may be costly.

ADDITIONAL LOCAL SUPPLIES

As discussed in Chapter 5, about 49 percent of the county's regulated streamflow has been developed into local water supply. The local inflows into a number of the District's reservoirs are larger than what can be developed into water supply yield; hence, there is potential to increase local yields by increasing the District's reservoir storage capacity and/or recharge capacity.

Existing local supplies can be limited due to either the existing reservoir capacity or the downstream recharge capacity. A reservoir may be too small to capture all of the reservoir inflows that could be developed into a beneficial yield. If a reservoir spills frequently, much of the flow that could have been developed into yield will instead flow to the Bay. On the other hand, the yield of a stream system could be limited due to the downstream recharge capacity. If the streamflows are much higher than the recharge capacity, the flow will not be fully developed. If more recharge capacity were developed on these streams, then more of the available local streamflow could be recharged to the groundwater basin, to be available later as water supply.

Studies have been performed for the District's reservoirs and downstream recharge facilities to determine the effect of increased reservoir capacity and/or recharge capacity on local water supply. One study has now been completed on inflatable dams that could be used year round instead of being removed in the fall. For most reservoirs, the yield is approaching the maximum for the system. Hence, increases in reservoir capacity and/or recharge capacity make only small increases in the local yield for most of the reservoir systems. However, there are three reservoir and stream systems in which increased reservoir and/or recharge capacity would increase the District's ability to use or store local or imported water, thereby more efficiently utilizing the District's existing sources of water. Three regulated stream systems that have the potential to develop a significant amount of additional local yield are Stevens Creek, Alamitos Creek, and Uvas Creek.

Stevens Creek

In Stevens Creek, all of the streamflow is derived from reservoir inflow. Therefore, all of the flow, which averages about 10,400 af/year, is regulated by the dam and reservoir. This flow has the potential to be captured and put to use as water supply yield, either when demands require it or when downstream recharge capacity is available.

With the existing reservoir, which has a storage capacity of 3,465 af, and the downstream recharge system, only 32 percent of Stevens Creek Reservoir inflow is developed into local yield. More local yield could be developed by increasing recharge capacity downstream of the reservoir. Land values in the Stevens

Creek area are high, and there are few areas that are currently undeveloped and suitable for percolation ponds. In this case, groundwater injection wells may be a possibility for increasing the amount that can be recharged into the groundwater basin; however, this option may require treatment facilities. Another alternative may be to divert the streamflow to another watershed for recharge into the groundwater basin. In any of these cases, an analysis of the groundwater basin is needed in order to determine the areas where groundwater recharge will benefit the basin. The alternatives for increasing local yield from the Stevens Creek Reservoir system will be investigated in the Integrated Resource Plan.

Alamitos Creek

Because of its location in the District's water utility, Calero Reservoir can store local water as well as temporarily store imported water from the San Felipe Project and the SWP. The local water can either be the inflow that directly enters Calero Reservoir, or Almaden Reservoir inflow that has been diverted through the Almaden-Calero Canal rather than flowing into Alamitos Creek. Though the yield from Calero Creek is only about 54 percent of the streamflow, a large percentage of the streamflow is downstream accretion, which is unregulated by the upstream dam and reservoir. Therefore, as a percentage of the reservoir inflow, the yield developed on Calero Creek is actually quite high. However, as shown in Table 5.1, the yield from Alamitos Creek is only about 38 percent of the streamflow, of which Almaden Reservoir inflow makes up about 93 percent. Therefore, there is potentially more local yield that could be developed from Alamitos Creek through expansion of the Calero Reservoir and downstream recharge system or adding pumping capacity to bring more flow into the Almaden pipeline.

In addition, Calero Reservoir can provide storage capacity for San Felipe water brought through the Cross Valley Pipeline and for SBA water brought through the Almaden Valley Pipeline when the pipeline systems have capacity. The water stored in the reservoir can then be released back into the District's Almaden Valley Pipeline during peak demand periods. Therefore, increasing storage capacity in Calero Reservoir has the added benefit of increasing the operational flexibility of the District's raw water system, as well as developing additional local yield. The benefits, cost, and potential constraints of raising Calero Dam will be investigated during the IRP.

Uvas Creek

The Uvas Reservoir system at times has very high reservoir inflow and downstream accretion streamflows in relation to the reservoir's size and existing recharge capacity. Uvas Reservoir spills quite frequently because the average reservoir inflow of more than 27,000 af/year is much larger than the reservoir capacity of

9,950 af. The yield from Uvas Creek is about 8,000 af/year and is only about 16 percent of the total streamflow and 30 percent of the reservoir inflow. Therefore, more local yield could be developed from the Uvas system with increases in reservoir and/or recharge capacity. Because the areas around Uvas Creek are less developed and urbanized, there may still be suitable undeveloped areas for recharge ponds. Studies investigating the viability and cost of raising Uvas Dam, increasing recharge capacity along Uvas Creek, and diverting the water into another watershed for recharge will be performed.

Inflatable Dams

The installation of two inflatable dams to recharge water year round in Guadalupe River has been investigated. The operating criteria was to deflate the dams if the flow exceeds 100 cfs and if water is available to allow 5 cfs to pass downstream. During the wet period of 1982-83, very little benefit was realized since the 100 cfs maximum flow is exceeded frequently and the dams are not allowed to operate. But during a dry period, 1988-89, an additional 1,200 acre-feet of water was recharged during the winter period of October through April by the use of inflatable dams. Other locations for inflatable dams will be investigated.

SUMMARY

Many new sources of supply are available for meeting the county's water supply shortage. The District and/or local agencies could develop reclaimed water for nonpotable use, recharge reclaimed water for potable use, or export reclaimed water to the Delta or San Joaquin Valley in exchange for other water sources. The District could arrange for CVP or SWP water transfers from project contractors or independent agencies. The State Drought Water Bank could become a resource for water transfers to the District in the event of a critical dry year. Development of a desalination plant is another option, as is the application of gray water for residential landscape irrigation. The District could also increase local water yields by augmenting local reservoir storage and/or recharge capacity within the county.

Each of these options is replete with often-complex technical, political, and financial issues. The District continues to explore these issues and will keep its Board members, interested agencies, and the public informed of its progress during the Integrated Resource Planning.

Chapter 10

Supply Side Management

Chapter 10
SUPPLY-SIDE MANAGEMENT

This chapter describes the advantages and disadvantages of various modifications or additions that could be made to the District's water supply facilities. These improvements can help meet the county's future water needs by increasing the efficiency with which existing local and imported supplies, and future water transfers, are used.

EXPANSION OF RINCONADA WATER TREATMENT PLANT

The expansion of Rinconada WTP may provide a water supply benefit to the District in the form of reduced future water transfer requirements. It may be difficult for the District to meet the future water needs of the county's northwest area due to the area's growing water demands and the ability of the groundwater subbasin to meet that demand. An expanded Rinconada WTP would provide additional system capacity, increasing the operational flexibility of the northwest portion of the District's system.

Rinconada suffered significant damage during the 1989 Loma Prieta earthquake and was only able to remain operational after the earthquake because a portion of the plant had not been operating at the time of the temblor. Rinconada was more vulnerable than the District's other two plants because the process equipment at Rinconada is on the surface and not submerged as it is in the other plants. Expansion of the Rinconada WTP with new submerged process equipment would supply greater reliability in the event of an earthquake.

Additional work will be performed during the IRP to determine both the capital and operation and maintenance costs for increasing the mechanical reliability of the plant for earthquakes, complying with new water quality regulations, and adding more plant capacity.

NEW SOUTH COUNTY FACILITIES

The 1975 Master Plan recommended that a San Martin WTP be considered as an alternative to meet South County water needs. At that time, the decision whether to build this plant was deferred because it depended upon refining water demand projections for South County and determining the operational capability of the Llagas groundwater basin. Subsequently, the District evaluated alternatives to meet South County water demands in a 1983 report. The recommendation of this report was to add recharge facilities to utilize only the groundwater basin to meet the projected water needs of the area. However, the report did not eliminate the possibility that a water treatment plant would be required in the future. It recommended periodic reevaluation of the recharge alternative, especially if groundwater quality should deteriorate to an unacceptable level or if the basin did not have the capacity to recharge and transmit the anticipated quantity of water needed.

Recently, more detailed studies have been performed to estimate the recharge capability of the sites identified in the 1983 report. These studies found that the recharge capacity of these sites is lower than was estimated, and existing facilities in South County—plus the proposed recharge ponds—will not be able to meet the area's projected future water needs. Additional facilities in the South County will be needed: either additional recharge capacity and groundwater pumping, or a new WTP. A simulation of the District's existing facilities showed that South County water needs can be met without overdrafting the groundwater subbasin if a new 25 mgd South County WTP is built. The amount of future water transfers required in the case of additional recharge or a new WTP is approximately the same. Therefore, at this stage, it appears that the two options are comparable.

Other options to be investigated include alternative methods of recharge, such as injection wells for groundwater recharge, and alternative South County groundwater recharge percolation ponds.

ADDITIONAL GROUNDWATER STORAGE

THE IMPACTS OF SUBSIDENCE
Groundwater subsidence has occurred in Santa Clara County in the past. Most recently, between 1960 to 1965, the ground dropped approximately 2 feet in some areas of the county. During this century, some areas have subsided more than 12 feet. Subsidence results in costly impacts on infrastructure. As land subsides, the skin friction on well casings causes wells to collapse. Subsidence can cause sanitary sewers with very flat grades to lose flow capacity and bridge soffits to encroach further into the backwater from the Bay during a flood. Once subsidence occurs, Bay and channel levees cannot provide the same level of flood protection unless raised to their original elevation. Subsidence would also make it necessary to add pump stations for the storm drains near the Bay in order to pump drainage into outfall channels.

Groundwater storage allows water to be carried over to a hydrologically dry period when the supply is needed. Currently, the District manages the groundwater subbasin to prevent land surface subsidence from occurring. Groundwater levels, recharge, and pumping are all monitored so that groundwater levels are kept above the threshold where subsidence is expected to occur. The operational storage capacity of the groundwater basin is based upon the storage available above this subsidence threshold.

However, additional groundwater storage is available below the subsidence threshold. Overdrafting the basin once the subsidence threshold has been reached may cause subsidence. The amount and location of groundwater pumping, and the length of time that the basin is below the subsidence threshold, influence whether and at what rate subsidence will occur.

Detailed studies are needed to delineate the costs on infrastructure, and groundwater model studies are needed to determine the amount of groundwater storage capacity that exists below the subsidence threshold, to predict the type of recharge and pumping scenarios that would cause subsidence to occur, and to determine where it would occur and at what rate. These studies should also investigate the effect of repeated episodes of overdrafting the basin.

ADDITIONAL SURFACE STORAGE

Additional surface storage could be utilized to capture more local flows, to provide more storage capacity for existing contracted imported sources, or to store future water transfers or reclaimed water. If located near the SBA or the San Felipe Project, additional surface storage could also increase the District's ability to more efficiently utilize existing contract amounts of imported water. This water could be stored for use during later times of need or when system capacity is available.

ANOTHER DISTRICT'S EXPERIENCE WITH A PROPOSED NEW RESERVOIR

The planning and regulatory process for new reservoir construction can be long, quite costly, and not always successful. In 1989, the East Bay Municipal Utility District (EBMUD) adopted a Water Supply Management Program (WSMP) and certified the WSMP Final EIR as a program-level document. One of the program elements included in the plan was additional terminal reservoir storage, with the first preference of local storage being the Buckhorn Reservoir site. EBMUD was subsequently sued by four different parties over alleged inadequacies in the EIR. EBMUD decided to address the concerns raised by the litigants by embarking on a $15 million effort to prepare an updated WSMP and develop a combined Draft EIR/EIS. In December 1992, the Draft EIR/EIS was issued. Though additional surface storage was included in the composite programs compared in the report, it was not carried forward for the "Proposed Action." The Proposed Action includes groundwater storage as the "environmentally superior alternative for increasing storage and water availability."

In very wet years when there is an abundance of local water, imported water that could not be utilized at the treatment plants or recharged into the groundwater basins could be stored for future use. Additional surface storage would also give the District the ability to take water transfers during wet years when more water of potentially higher quality may be available, and store it for later use. This would increase water supply reliability during times of low local and imported water supplies and possibly increase water quality.

However, it is becoming increasingly difficult to get project approval for a new reservoir in the current regulatory environment. Very often, the construction of a dam will have significant environmental impacts on wetlands and species under the protection of federal or state regulations. Impacts on wetlands are regulated by the Corps through the Section 404 permit process of the Clean Water Act. Species may be protected through the 1973 Federal ESA or the 1984 California ESA. In addition, a proposed activity such as the construction of a dam would be subject to the environmental requirements of the CEQA and the NEPA.

Even though a new reservoir may be viable from the perspective of water supply benefits and site availability and suitability, it may not be as viable as other components in terms of regulatory approvals.

As with many of the other components, the District has begun to investigate several options for increasing surface storage; these are described below. All of the options will require further detail study in order to determine project feasibility and to evaluate the associated impacts and benefits.

Expand Anderson Reservoir

The location of Coyote and Anderson Reservoirs makes additional storage in these facilities a potential alternative. However, expansion of Coyote Dam is not feasible because of geologic and seismic concerns at the existing abutment. Additional reservoir storage in Anderson could provide long-term carryover storage for water imported from the San Felipe Project or water transfers brought through the San Felipe system. From a preliminary investigation, the reservoir storage could be increased by 150,000 to 200,000 af.

Raising the existing dam at Anderson may be less costly and have fewer environmental impacts than the construction of a new reservoir. However, there are several possible constraints to the expansion of Anderson Reservoir. Some environmental issues include the known presence in the Anderson watershed of several species of concern which may be listed as endangered in the future. Land use issues are also a constraint because some of the area around the reservoir has been developed, and a number of homes and property owners would be impacted. Access and road relocations would also be an issue. In addition, there are potential constraints on reservoir expansion due to possible soil and groundwater contamination at the northern end of the site. Issues about District liability for water stored in a different watershed would also have to be investigated. Future studies on reservoir storage during the IRP should address these issues.

New In-County Reservoir

By capturing local runoff, a new in-county reservoir may develop a small amount of additional local yield. However, the main purpose and value of a new reservoir would be its ability to store imported water, either existing entitlements or water transfers. Currently, during locally wet years, the District cannot import and utilize all of its imported entitlements. A new reservoir would increase the District's ability to maximize its existing entitlements by providing the storage for unused entitlements, thereby increasing system reliability. In addition, water transfers could be stored for use during a later time of low local supplies.

The District's water supplies and facilities are vulnerable to distribution outages from earthquakes, hazardous chemical spills, and other supply disruptions. In recent years, there has been increasing seismic activity in areas surrounding the District's water supply sources. Hazardous chemical spills continue to be a threat to groundwater supplies and water that is transported through the Delta. Though disaster preparedness plans are certainly useful, construction of facilities to provide system redundancy and emergency water supplies may also be required. A new in-county storage reservoir could provide greater system reliability for these emergencies.

In August 1991, the District completed a ''Preliminary Evaluation of Alternative Dam and Reservoir Sites.'' It was a first-level look at 13 possible reservoir sites, in largely undeveloped areas, that could be integrated into the District's facilities because of proximity to the conveyance system of the San Felipe Project. This preliminary analysis identified six reservoir sites that appeared most viable and recommended them for more detailed studies.

The District then completed the ''Reconnaissance Level Evaluation of Alternative Dam and Reservoir Sites'' in February 1993. The purpose was to identify potential constraints on the development of dams and reservoirs, and to characterize the nature and the significance of the constraints. The Reconnaissance Study also identified those areas for which more detailed studies would be required. Reconnaissance-level cost estimates were developed to indicate the alternative's projected magnitude. Reservoir construction costs vary greatly depending upon reservoir location and final design, with smaller reservoirs at some sites costing much more than larger reservoirs at other sites. The cost estimates did not include environmental studies or mitigation, operation and maintenance, or the cost of any additional water transfers. Cost estimates for reservoirs at the six alternative sites with sizes from 150,000 af to 350,000 af ranged from $170 to $550 million in 1992 dollars.

Potential constraints at all of the sites include wetlands and species issues. Detail studies need to be completed to determine their impact on the possible development of a dam and reservoir.

Constructing a new reservoir is an enormous task. An example of a successful reservoir project is the Los Vaqueros Reservoir by the Contra Costa Water District.

Los Vaqueros Reservoir

In view of DWR's difficulties in providing additional water supplies for the SWP, in the 1980s the District began looking for alternatives. In October 1988, the District participated in an agreement among the three SBA contractors to evaluate participation in Contra Costa Water District's (CCWD) proposed Los Vaqueros Project. The findings and conclusions of the studies were presented to the District's Board in January 1989. Because of the project's high costs, limited benefits, and uncertainties, the District decided not to participate in the Los Vaqueros Project at that time.

CCWD has continued to pursue the Los Vaqueros Reservoir Project. They began planning the $450 million project in 1985 and estimate that construction will be complete in 1997. Of the total cost, about $250 million is for the dam and pipeline construction and road and utility relocations. About $200 million is for items such as land acquisition and environmental studies, plus administrative and legal expenses.

In April 1994, the project passed two federal regulatory hurdles. The U.S. Bureau of Reclamation signed off on the project's EIR. In addition, the Corps issued a wetlands permit for the project under Section 404 of the federal Clean Water Act. The Los Vaqueros Reservoir Project has been a large undertaking for CCWD in terms of duration, person-hours, and dollars. It appears now that those efforts will successfully result in the construction of a new reservoir. The final size of the reservoir will preclude other agencies from participating.

Los Banos Grandes Reservoir

The proposed Los Banos Grandes Reservoir Project (LBG) is an offstream storage facility located south of the Delta in western Merced County just south of San Luis Reservoir. It is part of the DWR's effort to provide the operational flexibility needed to meet the "water banking" concept approved by the legislature in 1984. LBG was specifically authorized by the legislation. The water banking concept involves the storage of water in facilities south of the Delta during periods of high winter flow for later release to meet needs during drier periods, thereby reducing summer demands for Delta exports. By reducing exports during late spring and summer, more water remains in the Delta system to maintain water quality standards and reduce the impacts to the Bay-Delta fishery.

DWR has completed studies on the feasibility of the proposed LBG project, and prepared a Draft EIR, dated December 1990, for the project. The project would be operated to increase the SWP dry period yield.

The LBG facilities would consist of a 1.73 million af off-stream storage reservoir with associated pumping-generating plants and conveyance channels. The project would store intermittent high flows conveyed through the California Aqueduct from the Delta, and also generate power by releasing water to Los Banos Reservoir (about 35,000 af capacity), which would function as a forebay. LBG would retain about one-half to two-thirds of its volume each year to reduce shortages during below-normal, dry, or critically dry years.

The District expressed its interest in participating in LBG by letter in May 1992 to DWR Director David Kennedy. At that time, DWR planned to allocate the additional project yield to all participating SWP contractors, probably on the basis of their maximum annual SWP entitlements. Because of the cost of the project, it may be infeasible for some agricultural contractors of SWP water to participate in LBG.

The State Water Contractors and DWR have recently agreed to conduct a 5-year Los Banos Grandes Planning Program, scheduled to begin during the 1994-95 fiscal year. The purpose of the program is to provide the information required to make a decision on proceeding with final design and construction of additional storage facilities south of the Delta.

Two concurrent tracks of work are proposed. In the first track, limited-scale work focused on LBG facilities will continue, with the purpose of maintaining the validity of completed environmental studies, continuing collection of baseline data, and completing studies for potential mitigation techniques. In the second track, all potential storage sites south of the Delta will be reevaluated in recognition of changes in environmental regulations that have occurred since completion of the 1990 report. The capacity requirements of the storage facilities will be reassessed to reflect the expected future availability of Delta exports and the needs and financial capabilities of the participating contractors.

The District will approach DWR and inquire as to the possibility of buying a portion of the LBG storage capacity and operating it independently of the SWP. There could be a number of advantages to this reservoir storage alternative as compared to the construction of a new in-county reservoir: fewer environmental impacts, less cost, and less time to implementation.

Upper Del Valle Reservoir

The District participated with the other SBA contractors to identify and evaluate alternative projects for new off-stream storage reservoirs that would provide additional water and emergency supplies, and improve the capability and water quality of the SBA system.

The first phase of the investigation was a reconnaissance-level screening of alternative storage and conveyance projects along the SBA. In a report dated February 1990, a new reservoir (Upper Del Valle Dam and Reservoir)—which could be constructed at the upper end of the existing Lake Del Valle, a feature of the SWP in southeastern Alameda County—offered the best opportunity for the SBA contractors to improve their water supplies.

Three alternative water supply sources were evaluated for the reservoir project. The three sources include unscheduled or surplus water in the Delta, water purchased in the Central Valley area, and advance deliveries of SWP entitlements. A thorough analysis was made of each alternative. It became evident to the SBA contractors that it was not possible at that time to realistically quantify the amount of water supplies that would be available for export from the Delta for the project. The SBA contractors decided in April 1993 to postpone completion of the studies until meaningful information could be obtained regarding potential water supplies for the project.

WATER BANKING PROGRAMS

The basic concept of a water banking program is that one party transfers water to another during normal and wet years, and the water (or a portion of it) is transferred back again during dry years. Banking programs commonly involve either actual groundwater recharge of the banked water, or ''in lieu'' recharge through direct use of the banked surface water in place of groundwater pumping. During return years, groundwater is used in place of surface water that is transferred back to the banking entity, and/or a certain amount of crop conversion or fallowing occurs.

A RECENT WATER BANKING AGREEMENT

Occasionally, surface water storage may be available for a banking program. In 1993, the District transferred 5,650 af of CVP water to San Benito County Water District (SBCWD) for storage in San Justo Reservoir. The banking agreement provided for SBCWD to keep 10 percent of the total quantity transferred for its own use. In addition, to account for seepage and evaporation losses, the balance due to be returned in each year will be reduced by an additional 10 percent. Returns will be accomplished through transfer of SBCWD's CVP entitlement in future years.

Finding a banking partner that is willing and able to take the District's unused CVP, SWP, or transfer water in normal and wet years, and return water in dry years, has proved to be a challenging task. In recent years, new regulatory restrictions have severely impacted the reliability of water supplies in the Delta export area, particularly those of CVP and SWP irrigation contractors. There are fewer water districts willing to disrupt the farming operations of their water users to accommodate a banking program. The benefits to the banking partner are not always readily apparent or quantifiable: improved dependability of "average" water supplies (offset by greater shortages, possibly, in dry years); substitution of surface supplies in lieu of higher-cost groundwater pumping; and reduction in groundwater pumping costs due to raising the water table.

Provisions of a banking agreement generally include the sources and quantities of water to be banked; the period of time in which banking and withdrawals can occur; provisions for conveyance and evaporation losses, and aquifer losses if water is stored in a groundwater basin; economic benefits and costs; and criteria regarding annual operation of the program. A key feature of a banking agreement is the exchange ratio, or the water kept by the banking agent. Exchange ratios of existing programs have ranged from 10 percent to 50 percent. The smaller exchange ratio generally is intended to cover seepage and evaporation losses only, and is accompanied by a significant monetary banking fee ($150 to $200 per af) to store the water. The larger exchange ratio generally is accompanied by more modest monetary banking fees intended to cover the banking party's variable costs only.

At this time, there is only one program, developed by a SWP contractor, that appears to be immediately viable for the District. Semitropic Water Storage District (Semitropic) has been developing this program for at least 10 years, and is currently in the process of negotiating an agreement with Metropolitan Water District of Southern California and completing environmental documentation. The Semitropic banking program would involve a relatively small exchange ratio (about 10 percent), but a significant banking fee of $150 to $200 per af. The underlying purpose of their banking program is to provide the financing necessary to improve conveyance, pumping, and groundwater recharge/extraction facilities, and to reduce the cost of water to their irrigators.

The District has also discussed the possibility of banking water with the San Joaquin River Exchange Contractors Water Authority, since the exchange contractors have one of the most reliable water supplies in the Delta export area. However, the exchange contractors are limited in their ability to store water because any water conveyed to them in federal facilities (e.g., the

Delta-Mendota Canal) would have to be used on lands which meet the acreage limitation requirements of the Reclamation Reform Act (RRA). Since the exchange contractors have historically, under their own CVP contract, not been required to comply with the RRA, much of their demand for water is on excess or ineligible lands. In order for a banking program to work with the exchange contractors, the District would have to find a way to deliver water to them through nonfederal facilities and/or build groundwater recharge and extraction facilities so that the program could be based on physical recharge instead of ''in lieu'' recharge.

One or more water banking programs could provide significant dry year supplies through banking of existing CVP and SWP supplies in normal and wet years. The District could also use banking programs to store transfer water that could not be used in Santa Clara County in a given year. The potential risk is that if the basin in which the banking is occurring is being overdrafted then the basin could be adjudicated and the District could lose this storage option.

SUMMARY

Many options exist for additions and modifications to the District's water supply facilities that would help meet the county's future water supply needs. The District could expand the capacity of the existing Rinconada WTP, build a new South County WTP, or build additional recharge facilities in the southern part of the county. Additional groundwater storage could be used, but at the risk of subsidence. There are also several options available to increasing surface storage. In-county storage could be increased by expanding the existing Anderson Reservoir or building a new in-county reservoir. Participation in the LBG or an Upper Del Valle Reservoir project could also increase the District's surface storage. A water banking program with an entity outside the county is yet another way to provide additional storage.

Each of these options is complex, and each has positive and negative implications for the District, further detailed investigations will be completed during the Integrated Resource Planning.

Chapter 11

System Operation Management

Chapter 11
SYSTEM OPERATION MANAGEMENT

This chapter describes the District's existing operational priorities and identifies modifications to current operations that could provide additional supply reliability for the county. These modifications include using imported water before local water, using CVP water before SWP, and storing imported water in local reservoirs. The chapter also explores the water supply benefits and legal issues related to the District becoming the master contractor for Santa Clara County's Hetch Hetchy water supply.

THE EXISTING WATER SUPPLY SYSTEM

The District provides the county's local water supplies by managing surface water and groundwater. Surface water reservoirs were constructed to augment the groundwater basin's natural supply and to alleviate ground surface subsidence caused by overpumping of the groundwater basin. The surface reservoirs retain runoff behind earthen dams during wet months and the water is released by the District for percolation into the groundwater basin or to pipelines for treatment during the drier months.

The source of the District's imported water supplies are the state and federal water projects which pass through the Delta. The District began importing water from the SWP in 1965 via the SBA. The SBA delivers imported water to the northern portion of the county where the District treats it at one of two treatment plants or delivers it to artificial recharge facilities.

The District began receiving federal water in 1987. The federal water enters the southern end of the county where the District transports it to WTPs. Any remaining water is percolated in artificial recharge facilities to the groundwater basin. During wet hydrologic periods when the groundwater basin's storage is near capacity, more local water can be treated and less imported water needs to be delivered.

MODIFICATION NO. 1: PRIORITIZING IMPORTED WATER OVER LOCAL WATER

Historically, the District has utilized its local water supplies before its imported supplies for four major reasons. First, the local supplies have the lowest unit cost, $40/af, versus imported water at $120/af, all in 1994 dollars. Second, unless the local water is used, the following year's runoff has the potential to fill the reservoirs which could then spill water to San Francisco Bay. Third, the imported supplies were expected to be used at the treatment plants and any excess imported deliveries were intended to augment local water supplies recharging the groundwater basin. And finally, the historical operation of the local reservoirs has provided incidental flood control storage for the valley. Until the major creeks of the county are constructed to pass a 1-in-100-year flood event, a change in reservoir operation may increase District liability during flooding.

By prioritizing the use of imported water over local water, the District could utilize more of its imported water deliveries through a wider range of hydrologic conditions. Essentially, more imported water would be used during wet hydrologic periods when its availability is greatest. This would result in additional local water being stored in the District's reservoirs. The local water could then be released to augment the imported water deliveries to the percolation facilities and treatment plants. It is estimated that the county's need for additional supply could be reduced by 15,000 af/year during the design CDP with this change in operation.

Any local water left in the reservoirs would remain as carryover storage and act as a supply buffer for any future drought period. But because the carryover storage would be greater, additional local water would spill to San Francisco or Monterey Bay. There may also be a higher potential for localized flooding associated with the increased reservoir spilling.

Hetch Hetchy could also be prioritized over local water and an additional savings in supplies should result. However, the District does not control this supply and cannot prioritize its use. This obstacle could be overcome if the District became the master contractor for all Hetch Hetchy water delivered within the county.

HETCH HETCHY MASTER CONTRACT

The SFWD administers the delivery of Hetch Hetchy water in Santa Clara County and serves nine different agencies. The agencies receiving Hetch Hetchy water include service areas in the cities of Milpitas, Mountain View, Palo Alto, San Jose, Santa Clara, Sunnyvale, Purissima Hills Water District, and Stanford University. The estimated annual deliveries are 76,000 af/yr. The cities of San Jose and Santa Clara have interruptible supply contracts whereby Hetch Hetchy can discontinue deliveries to the two cities with a 2-year notice. These deliveries represent approximately 11,500 af/yr of supply to the county. Hetch Hetchy has an intertie with the SBA on the SWP. Conceivably, the District could receive excess Hetch Hetchy water deliveries or transfers via the SBA. An intertie is also being planned from the District's Milpitas pipeline to the Hetch Hetchy aqueduct.

The District believes that Hetch Hetchy water deliveries could be managed in conjunction with the District's supplies to increase the long-term reliability of the county's water supply. The benefits of having a Hetch Hetchy Master Contract became clear during the recent drought of 1987 to 1992. During this drought, the District developed mandatory conservation goals to temporarily reduce the county's need for water. Since then, other permanent water-saving programs have been developed. They include nonpotable reclamation, the ULFT rebate, and low-flow showerhead programs. These efforts are countywide and include those cities that receive both District supplies and Hetch Hetchy water. One of the results of the conservation effort is a demand reduction in the Hetch Hetchy service area at no cost to the SFWD. The Hetch Hetchy water that is conserved through these programs increases the yield of the Hetch Hetchy system and can be delivered to other Hetch Hetchy contractors. If the District had a master contract, any Hetch Hetchy water saved through the District's programs could be used to supply water to the District's treated water system or recharge the groundwater basin, thereby increasing the long-term reliability of the county's supplies.

Legal Considerations

There are certain restrictions on the City and County of San Francisco that may preclude the District from becoming a master contractor for Santa Clara County's Hetch Hetchy water supply. Foremost among these is the Raker Act. This federal legislation granted the rights of way and water rights of the Hetch Hetchy water supply system in Yosemite National Park and adjacent Stanislaus National Forest. The act prohibits the City of San Francisco from selling Hetch Hetchy water to corporations (e.g., private water companies) for resale. The City of San Francisco has historically justified such sales as being limited to the yield of local SFWD supplies such as local water developed in the Calaveras Reservoir watershed. Current sales to water companies are near the limit of the local yield of the SFWD's system. A strict interpretation of this provision would mean that the District could not sell Hetch Hetchy water to the San Jose Water Company and the Great Oaks Water Company, or in the extreme case, could not recharge excess Hetch Hetchy water into the groundwater basin where it could be used by these two agencies.

Another restriction that could adversely affect the ability of the District to act as the wholesale contractor for Hetch Hetchy water is the Settlement Agreement between the City and County of San Francisco and the 30 suburban contractors on the system. The parties agreed in the Settlement Agreement that SFWD would not sell water outside of the City of San Francisco's city limits to any purchaser that was not purchasing water from the Hetch Hetchy system prior to June 30, 1983, if that sale would impair Hetch Hetchy's ability to fulfill the supply assurance (delivery floor) to the suburban contractors of 184 mgd. Since the SFWD safe yield of Hetch Hetchy and San Francisco's local supplies (242 mgd) is currently less than the supply assurances plus the City of San Francisco's demands (285 mgd), any new customer will not be entitled to permanent, noninterruptible deliveries.

In addition, the Settlement Agreement prohibits each suburban purchaser of Hetch Hetchy water from delivering SFWD water outside the service area designated in its water supply contract with SFWD. Therefore, unless the suburban contractors in the county are released from this obligation of the agreement, they could not deliver excess water to the District for use in other areas within Santa Clara County.

There are two ways in which the District could become a Hetch Hetchy wholesale supply contractor: entering into a separate suburban contract with SFWD, or becoming a signatory to a modified Settlement Agreement subject to the approval of the county's suburban water purchasers.

If the District were to act as a separate suburban contractor, the District could be both a customer and a wholesaler of Hetch Hetchy water. By defining a service area that included the county's eight Hetch Hetchy contractors, any excess Hetch Hetchy water from the county's suburban contractors could be accepted by the District and delivered within the defined service area. However, in the role as customer, the District's contract supplies would not be permanent because of SFWD's need to meet the suburban supply assurances of the system.

The second way for the District to become a Hetch Hetchy wholesaler is to modify the Settlement Agreement. If the District were a signatory to a modified agreement where the District was strictly the Hetch Hetchy wholesaler for the county's eight suburban contractors, the agreement could grant to the District delivery of water equal to the total permanent delivery entitlement of the six water agencies with permanent supplies, and the equivalent temporary supplies of San Jose and Santa Clara. It is not known at this time whether a Hetch Hetchy master contract would require an amendment to the Settlement Agreement or whether it would require a separate agreement. There would have to be some mechanism to transfer to the District the rights granted by the agreement to the participating agencies.

MODIFICATION NO. 2: PRIORITIZING CVP WATER OVER SWP WATER

The SWP enters the north end of the county which is the most populous region and hence has the greatest water needs. In general, the SWP has been prioritized over CVP water because it can serve this populous area most efficiently.

System simulation studies have demonstrated that prioritizing District CVP water deliveries over SWP water use could benefit the county's water supply. The CVP draft M&I Shortage Policy dry year allocations are based on the historical average of the last three normal-year deliveries. Prioritizing CVP water over SWP water maximizes CVP deliveries and establishes a higher historic average. Maintaining consistently higher deliveries of CVP water would result in less variability in CVP deliveries to the District, which would translate into greater reliability at the same cost. During a critical dry period, the county's need for additional water supply would be reduced by 20,000 af/year if CVP water were prioritized over SWP deliveries.

When prioritizing CVP water over SWP water, there is the direct benefit of raising the CVP historical average deliveries; however, the SWP deliveries to the District are simultaneously reduced. There is no facility in the North County that can store the displaced SWP water, and hence it could be unused. However, by "wheeling" the displaced SWP water through the San Felipe Division of the CVP, the water could be brought into the south end of Santa Clara County.

An issue that will affect the relative supply benefit of prioritizing the District's CVP deliveries over the SWP deliveries is the Coordinated Operations Agreement (COA) between the Bureau and the DWR. The COA is the agreement between the SWP and the CVP on how to operate both projects to meet the water quality requirements in the Delta. If the CVP and SWP are required to share the supply impacts of Delta regulations equally, the District's CVP deliveries and the advantage of having a CVP M&I shortage provision may be reduced. If, however, the CVP's "first in time, first in line" philosophy prevails, then the CVP deliveries will benefit.

Currently, the SWRCB administers the water rights in California. This board believes that the COA can be modified through a change in the two projects' water rights. The issue of the COA may be resolved during the SWRCB's new triennial Delta Water Quality Control Plan, scheduled for completion in 1995.

MODIFICATION NO. 3: STORING IMPORTED WATER IN LOCAL RESERVOIRS

A third operational change would be to use Anderson or Calero Reservoirs as storage facilities for imported CVP deliveries or water transfers. Water in either reservoir could be used as a buffer for future dry periods. Utilizing available storage increases the District's ability to use its imported CVP supplies through a wider range of hydrologic conditions and maximizes CVP deliveries for the benefit of the CVP M&I Shortage Policy. Again, this would result in greater carryover storage to buffer future droughts. During a critical dry period, supplemental requirements would be reduced by 10,000 af/year.

The disadvantage of using Anderson or Calero Reservoirs for imported water storage facilities is the increased potential for flooding. With more carryover storage comes increased frequency and magnitude of spilling. Operational simulation studies indicate that spilling of local water from the Coyote Creek watershed increased by an average of 6,300 af/year and occurred an additional 16 times over the 31-year historic period of study. In contrast, with the addition of a pumping plant at Calero, the spilling of local water was eliminated. The simulations did not attempt to optimize the amount of imported water stored versus the frequency and magnitude of spilling of local water. To optimize that relationship, additional simulations and statistical analyses will need to be performed.

SUMMARY

Reprioritizing the use of the District's source of supplies has many benefits and some inherent risks. Utilizing the SWP and CVP deliveries over local water will assure greater imported water use over a wider range of hydrologic conditions and provide carryover storage of local water in District reservoirs; however, this operational modification may increase the potential for localized flooding or wasting local runoff to San Francisco Bay.

Using the CVP deliveries before SWP supplies has significant benefits in reducing the supplemental supply requirements during a drought. However, on the long-term average, some SWP deliveries will be displaced. The displaced SWP can be "wheeled" by way of the CVP's San Felipe Project through the south end of Santa Clara County and placed in short-term storage in Anderson or Calero Reservoirs or delivered to District percolation or treatment plant facilities.

The advantages of becoming a Hetch Hetchy master contractor include increasing the long-term reliability of the county's water supplies, facilitating the transfer of water between the District and the SFWD, and increasing operational flexibility in meeting the county's future water supply needs. However, the District's role as a Hetch Hetchy master contractor depends upon limitations contained in federal legislation (Raker Act) and clauses in the suburban contractors' delivery contracts.

Chapter 12

Possible Water Supply Alternatives

Chapter 12
POSSIBLE WATER SUPPLY ALTERNATIVES

This chapter explains in detail the assumptions that were used to analyze the District's water supply and develop alternatives for meeting the county's projected water shortfall. It also lists several alternatives that can satisfy the county's future water needs and explains the tradeoffs associated with some of the components of these alternatives.

BACKGROUND

By year 2020, a water supply shortfall of 215,000 af can be expected in the county during a critical dry period. Using the District's current surface and groundwater storage and effectively managing the water supply this shortage can be reduced to 175,000 af. Other less severe but nonetheless significant shortages could occur as early as year 2000.

District staff has identified a number of possible alternatives that could meet the county's year 2020 water shortfall. These alternatives encompass demand-side management, additional sources of supply, supply-side management, and modifications to the operations of the existing system. These alternatives are summarized in Table 12.1.

ANALYSIS ASSUMPTIONS

Simulation Models

Alternatives were investigated using the District's SYSMOD and EXTEND models that simulate the District's distribution system. Both models use a deterministic approach to analyze the county's entire water operations. This approach imposes future water needs upon historical hydrology. This is the accepted method of analyzing water supply problems because future hydrology is not biased by the user's assumptions, variations in historical hydrology are known, and similar variations are likely to recur in the future.

Hydrology

The limits of the District's water supply are defined by the critical dry period. To determine if the District's system can withstand a critical dry period, resumption of normal rainfall and runoff must occur. Hence, to complete a hydrologic cycle for planning purposes, future hydrological events must be assumed.

The District's SYSMOD and EXTEND models use a hydrological database that begins in 1967 with the last full year of actual data being 1991. The District extended the recorded data through the year 1996 to create an artificial 10-year dry period with a probability of severity of 1-in-100. The hydrology was then extended another 3 years at average supply to ensure system recovery. Since 1967, two drought events have occurred: the short duration but extremely severe drought of 1976 to 1977 and the current drought.

TABLE 12.1
Santa Clara Valley Water District
Potential Alternatives
to meet the County's 2020 water needs during a CDP

(ALL VALUES IN 1000s OF ACRE FEET UNLESS OTHERWISE NOTED)

	DEMAND-SIDE MANAGEMENT			NEW SOURCES OF SUPPLY					SUPPLY-SIDE MANAGEMENT					SYSTEM OPERATION MANAGEMENT		
	BMPs	Added Conservation Measures	Short-Term Water Use Reductions	Nonpotable Reclamation	Potable Reclamation	Grey Water	Desalination	Water Transfers	Enlarge Existing Reservoirs	New In-County Reservoir	New Banking Program	Expand treatment Plant	New Treatment Plant	Import Priority over Local	Imported Source Priority	Storing Imported Water Locally
			%						*Uvas*			*(MGD)*	*(MGD)*	*no*	*San Felipe*	*no*
ALTERNATIVE																
A	**0**	**0**		**0**				**175**								
B	**28**	**0**		**0**				**150**								
C	**28**	**17**		**0**				**130**								
D	**28**	**0**		**32**				**110**								
E	**28**	**17**		**32**				**90**								
F	**28**	**17**		**40**	**25**	**5**	**15**	**50**								
G	**28**	**17**		**32**	**25**			**75**								
H	**28**	**17**		**16**	**60**			**55**								
I	**28**	**17**		**16**	**60**			**15**		**350**						
J	**28**	**17**		**32**	**60**			**0**		**350**						
K	**28**	**17**		**32**			**15**	**75**								
L	**28**	**17**		**32**		**5**		**80**								
M	**28**	**17**		**32**				**65**		**150**						
N	**28**	**17**		**32**				**55**		**250**						
O	**28**	**17**		**32**				**40**		**350**						
P	**28**	**17**		**32**				**65**			**150**					
Q	**28**	**17**		**32**				**55**			**250**					
R	**28**	**17**		**32**				**40**			**350**					
S	**28**	**17**		**32**				**85**				**100**				
T	**28**	**17**		**32**				**95**				**120**				
U	**28**	**17**		**32**				**40**		**350**		**100**				
V	**28**	**17**		**32**				**75**						**yes**		
W	**28**	**17**		**32**				**35**		**350**				**yes**		
X	**28**	**17**		**32**				**110**							**SBA**	
Y	**28**	**17**		**32**				**70**		**350**					**SBA**	
Z	**28**	**17**		**32**				**95**					**30**			
AA	**28**	**17**		**32**				**90**	**20**							
AB	**28**	**17**		**32**				**80**								**yes**
AC	**28**	**17**	**30**	**32**				**0**								
AD	**28**	**17**	**10**	**32**				**60**								
AE	**28**	**17**	**20**	**40**	**25**	**5**	**15**	**0**								
AF	**28**	**17**	**10**	**40**	**25**	**5**	**15**	**25**								

Using the historical rainfall data, the District performed an extensive investigation of drought durations and severity. The 118 years of rainfall record at Rainfall Gage No. 86 (located near the San Jose Airport) were used for this analysis, as they represent the longest amount of rainfall data available on county hydrology.

The impact of a drought is determined by two major factors: the amount of water supply available (severity) and how long the drought lasts (duration). The first factor, drought severity, is related to rainfall. The rainfall totals in the current drought are shown to have a probability of severity of 1-in-100. The 1976 to 1977 drought is even more severe—a probability of severity of 1-in-214. The 1927 to 1934 drought that DWR uses to evaluate its system for firm yield has a severity of 1-in-120 in rainfall total. Hence, in the analysis of these alternatives, the planning assumption was to use the critical dry period with a probability of severity of 1-in-100. However, a drought of greater severity is possible, and were it to occur, facilities designed for the 1-in-100 severity level would be inadequate to meet the county's water supply needs.

To investigate the impact of duration, the current dry period was extended and every year that was added to the hydrological database continued the probability of severity of 1-in-100 for that dry period duration. For all the alternatives investigated, the subbasins began to recover in the eighth year, even though the drought lasted another 2 years.

Best Management Practices

A key premise of this study is that the District will continue to place a high priority on maximizing savings from permanent water conservation as a cost-effective, environmentally-sensitive partial solution to the county's long-term water supply deficiencies. Toward this end, in August 1991 the District signed an MOU for water conservation, thereby joining over 80 other water agencies throughout California committed to aggressively promoting conservation BMPs. Each of the alternatives developed by the District, except the no project alternative, assumes that the water conservation BMPs, as stipulated in the MOU, will be realized and that more than 28,000 af/year in permanent water use reduction will be achieved by the year 2000. By continuing the conservation programs beyond the MOU sunset of 2002 should develop another 17,000 af/year of water savings for a total 45,000 af/year.

Water Needs

To assess the county's water needs through year 2020, District staff analyzed historical dryness and temperature data and matched water needs with the historical hydrology for each year. That is, for very wet years such as 1982, water needs were reduced to reflect the very wet weather condition. During hot dry periods, rainfall is not available to irrigate outside landscaping as it normally would be; hence, more irrigation water is needed, which increases water demand. The analysis used year 2020 water needs projected for the full build-out of the county which varied because of the weather conditions. For an average weather condition, the county's water needs are estimated to be 515,000 af/year with water savings from plumbing code changes incorporated.

Storage

The amount of water from the county's three groundwater subbasins was calculated based on operational groundwater storage capacity. Operational storage capacity is that volume of groundwater storage between the operational maximum and subsidence threshold elevations. The carryover storage in the groundwater subbasin fluctuates from one year to the next within the bounds of the operational storage capacity. The operational storage capacity was modelled as follows: the Santa Clara Valley groundwater subbasin at 250,000 af; the Llagas subbasin at 150,000 af; and the Coyote subbasin at 55,000 af. The combined total groundwater storage capacity is 455,000 af. This storage was assumed to be entirely available for use and no groundwater reserves were put aside for emergencies. If emergency storage is required, the amount of operational storage would need to be reduced. This issue must be addressed in future work.

Treatment Plant Capacity

For all of the alternatives, the existing WTP capacities were assumed to be 75 mgd for Rinconada, 40 mgd for Penitencia, and 100 mgd for Santa Teresa. These plants were assumed to operate at full capacity throughout the summer months. The WTPs were also assumed to get first priority of all imported water supplies.

Recharge Capacity

The existing recharge capacity as described in the District's 1977 report was used, with the exception that 33,000 af/year of additional recharge capacity was assumed for the Llagas subbasin in the future. The total recharge capacity of these existing artificial recharge systems is 157,200 af/year.

Potable Reuse of Reclaimed Water

The maximum allowable blend of 50 percent reclaimed water and 50 percent raw water was assumed for recharging reclaimed water into the subbasin or adding it to surface storage. This yields the greatest amount of reclaimed water for recharge or use in one of the treatment plants.

Imported Water

The EPA's standards for salinity control for the beneficial habitat for breeding fish in the Delta also incorporates the requirements for winter-run salmon and Delta smelt and the striped bass spawning standard. DWR simulated these conditions in their DWRSIMs model and District staff incorporated the contract requirements south of the Delta. This was the basis for the quantity assumed for two of the District's imported supplies, SWP and CVP. For the other imported source, Hetch Hetchy, the hydrological impacts affecting the historical deliveries were assumed to continue.

Shortage Policy

The proposed CVP M&I shortage policy which will provide urban contractors a minimum of 75 percent of their historical supply (using a 3-year historical average of CVP water deliveries made pursuant to the contract) was incorporated into the analysis for all of the alternatives investigated. Currently, the District prioritizes imported water from the SBA and then supplements the remaining demands with San Felipe water. With this new shortage policy, the San Felipe water should be prioritized first. Over the long-term, this benefit is fairly minor, but during a critical dry period this policy becomes very significant. The 3-year historical average with San Felipe as the first priority for imported water is 30,000 af greater at the beginning of a critical dry period than with San Felipe as the supplemental source and SBA water as the first imported source. This provides more than 20,000 af more San Felipe water during the critical dry period with no change in the amount of South Bay water during this same period.

Water Transfers

State and federal water transfers must be requested and moved separately. In the analysis, water transfers were divided into two types: water transfers that enter the valley through the SBA and water transfers that enter through the south end of the county or the San Felipe Project.

WATER SUPPLY COMPONENTS

As described in Chapters 8 through 11, several types of components can be combined to form an alternative that would meet the water needs of the county. These include the following:

- *Demand-Side Management Components*—Efficient water use programs, mandatory water use reductions, and land use controls that limit new water demands.

- *New Sources of Supply*—Water reclamation (both nonpotable and potable), water transfers, the State Water Bank, desalination, gray water, and developing additional local supplies.

- *Supply-Side Management Components*—Enlarging existing local reservoirs, overdrafting the groundwater basin, building a new reservoir either in-county, at Los Banos Grande by the

SWP, or an Upper Del Valle Reservoir, using groundwater storage options in the Central Valley, expanding existing treatment plants, and constructing a new treatment plant.

- *Operational Modifications*—Using imported water before local water, using CVP water before SWP, storing imported water in local reservoirs, and making the District the master contractor for Santa Clara County's Hetch Hetchy water supply.

COMPONENT TRADE-OFFS

The alternatives developed are an attempt to meet the county's total supplemental water needs for the year 2020. These alternatives strive to achieve many water-related objectives: reliable water service, water reuse, conservation, reliable water quality, and environmental protection. The alternatives either meet the county's 2020 water needs or include mandatory reductions that must be imposed during a drought. They represent reasonable combinations of components; other combinations can be assembled to form different alternatives which may have to be investigated in the future.

The trade-offs associated with some of these components are explored below.

Short-Term Drought Measures

Short-Term water reductions of 10 percent depend upon the conservation assumed and the demand hardening expected to occur. (See Chapter 8 for a discussion of demand hardening.) The exceptions are the two alternatives that reflect no water transfers. These mandatory reductions for the alternatives investigated have a maximum of 30 percent and is estimated to represent a significantly greater hardship for the county than what has occurred in the past drought.

Conservation, Reclamation, Gray Water, Desalination

When comparing the alternatives, it can be seen that both conservation and nonpotable reclamation provide excellent reductions in the amount of water transfers that would be required. These two alternatives develop stand-alone systems that complement the District's existing system. This is also the case for both gray water and water that is desalinated and then transported directly to a retailer.

Nonpotable Reclaimed Water

Most of the alternatives anticipate the development of nonpotable reclaimed water. The District will not have direct control over this component but will have to depend on the wastewater agencies.

These agencies are motivated to develop nonpotable reclaimed water as a means to satisfy their discharge permits. To encourage this development, the District has adopted a Nonpotable Reclamation Policy that will financially contibute the estimated avoided cost of water for the valley to these projects. The District anticipates that 32,000 af of nonpotable reclaimed water will be developed by 2020.

Potable Reclaimed Water

Because of the existing guidelines, potable reclaimed water must be blended with other sources of water and then recharged into a groundwater basin or surface storage before it can be used. If injection wells are not used, then this water competes with local supplies for the limited existing recharge capacity of the District. But if this supply is blended and then stored in surface reservoirs, then greater quantities can be put into the existing system.

Water Transfers

The water transfer component is used in all but four of the alternatives to balance the amount of groundwater supplied by the subbasins and to keep the subbasins within their operational storage capacity. When water transfers are not used, then more stringent mandatory reductions balance the alternative. Water transfers range from a high of 175,000 af to a low of zero when all of the 2020 water needs are met without imposing mandatory reductions.

Additional Storage Capacity

When additional storage capacity is provided, the amount of water transfers are reduced. The largest storage reservoir (350,000 af) investigated shows the greatest benefit in reducing the amount of water transfers needed. The enlargement of Uvas Reservoir does not reflect a reduction in water transfers because only a small enlargement to the reservoir is believed possible.

Expanded/New Treatment Plant

The expansion of the existing treatment plants and the addition of a new plant has a mixed effect on the amount of water transfers needed. The expansion of the plant shows some benefit but this is balanced by the additional constraint upon the system that requires deliveries to treatment plants before recharge facilities. A new treatment plant would be located in the South County. Because the WTPs take higher priority on available imported supplies, the addition of a new plant would also further constrain operation of the existing system and require slightly more water transfers.

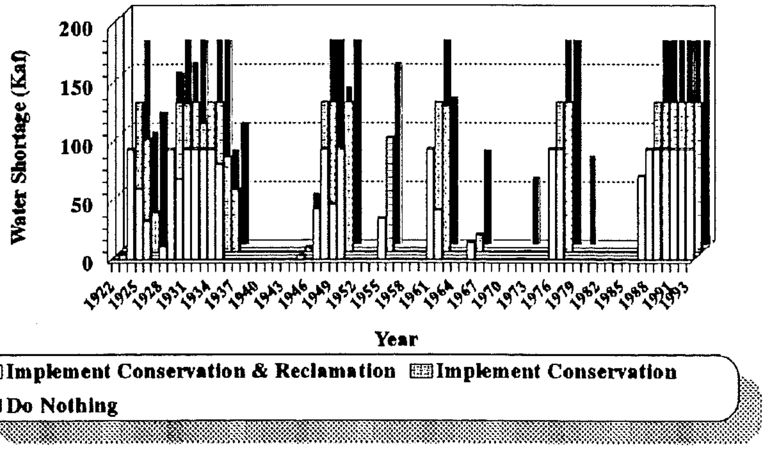
Operational Modifications

Prioritizing imported water over local water shows a benefit for all of the alternatives investigated. The risk for these alternatives is greater frequency and magnitude of flooding in the future, with possible greater District liability. Storing imported water locally shows the same results and has similar drawbacks. Importing San Felipe water before state water shows a benefit of at least 20,000 af during a critical dry period. With additional storage this benefit is even greater, because more San Felipe water can be contracted for and the 3-year historical average is increased even more at the start of a dry period.

2020 WATER SHORTAGES

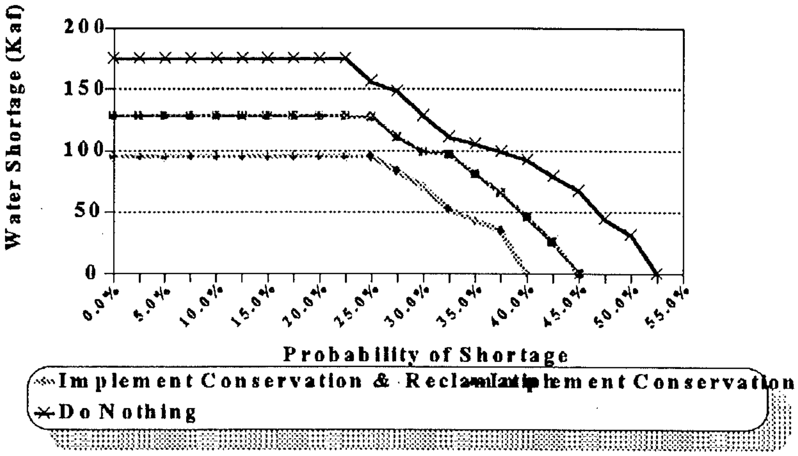
Three partial alternatives that do not satisfy the entire 2020 water needs of the county have been translated into water shortages that could occur. These three partial alternatives are the do-nothing alternative—the base condition that exists, an alternative that just implements all of the conservation savings that can be anticipated, 45,000 af/year above those from the plumbing code changes, and an alternative that implements these conservation efforts and nonpotable reclamation of 32,000 af/year. Figure 12.1 shows the shortages that would occur for these three alternatives. The do-nothing alternative shortage of 175,000 af/year can be reduced to 90,000 af/year with aggressive conservation and nonpotable reclamation programs but the frequency of occurrence is not significantly reduced.

FIGURE 12.1
Water Shortages for Three Partial Alternatives



Another way to view the impacts these partial alternatives have on the 2020 water shortage is by a cumulative frequency distribution. Figure 12.2 shows this distribution of the three partial alternatives. The shape of the distribution curves do not change very much; that is, severe water shortages can be expected to occur more than 20 percent of the time but with lower magnitudes of shortages.

FIGURE 12.2
Cumulative Frequency Distribution
of Three Partial Alternatives



SUMMARY

This Water Supply Overview Study has identified numerous challenges and problems for the District and proposed alternatives for meeting the county's anticipated water shortfall. These alternatives strive to achieve many water-related objectives, including reliable water service, water reuse, conservation, reliable water quality, and environmental protection. The alternatives are not exhaustive; additional alternatives could be developed with further study. The components of the various alternatives include demand-side management programs, additional sources of supply, supply-side management efforts, and modifications to existing system operations.

Chapter 13

Integrated Resource Planning

Chapter 13
INTEGRATED RESOURCE PLANNING

This chapter describes the IRP process and explains how the District will use it to facilitate the improvement of water supply and system reliability. It summarizes the need for additional water supplies to provide for the county's anticipated water supply shortfall, suggests screening criteria that must be developed to evaluate various water supply alternatives, and concludes with a brief outline of the recommended steps the District can take to conduct the IRP process.

A NEW PLANNING PROCESS

Traditional water resources planning investigates a number of alternatives with the goal of identifying the least-cost option. This approach does not attempt to build consensus and is narrowly focused to solve specific problems without evaluating secondary impacts. During the past 10 years, the traditional approach has proven difficult within communities that demand public agencies be more responsive to environmental concerns and local needs.

The East Bay Municipal Utility District's planning process for Buckhorn Reservoir typifies these difficulties. An EIR for the reservoir was rejected after many years and millions of dollars were spent on its development; the EIR is now being redone to evaluate factors affecting the project that were not previously given fair consideration. A new board of directors was elected because the community believed the previous board was not addressing local needs.

District staff began developing the Water Supply Overview Study with a similar, traditional approach in mind. In 1993, the staff conducted eight work study sessions with the District's Board on the water supply alternatives contained in the 1992 Draft Water Supply Overview Study. These sessions covered the alternatives in great detail, but after a year of deliberation, the Board had not reached a consensus on which water supply alternative the District should pursue.

Staff has since realized the limitations of attempting to build consensus for a single water supply alternative, even among the similarly-minded stakeholders on the District's Board. Rather than striving for agreement on one single alternative, the District may find it more useful to establish a procedure that will **build consensus on the underlying criteria for evaluating project alternatives**. This screening criteria would then be applied to all of the alternative projects to determine which would move forward to the next step in the planning process, an EIR. Screening criteria would be developed in an open and participatory manner to build consensus among competing stakeholder groups. The District's function would be transformed from advocating a single water supply alternative to providing leadership, vision, and technical expertise to facilitate countywide agreement and collaborative decision making. By building on a common understanding of problems and incorporating diverse interests, this process, known as an Integrated Resource Plan (IRP), can foster the development of an acceptable water supply solution.

In 1993, the Metropolitan Water District of Southern California (MWD) recognized the need to develop an open and participatory decision-making approach for future water supply alternatives that would meet their reliability objectives and started an IRP. Through the IRP process, MWD and its member agencies are working to determine the appropriate mix of resources that should be considered. Their process considers alternative costs and the resultant impacts on their water rates, as well as risk, reliability, environmental, and institutional factors. MWD believes this process will determine the best mix of alternatives to satisfy their stakeholders.

THE NEED FOR MORE WATER

After a thorough analysis, District staff has proposed the District design its water supply facilities to withstand the critical dry period that is a 10-year drought with a 1-in-100 severity. (However, a drought of greater severity is possible. Were it to occur, facilities designed for the 1-in-100 severity level would be inadequate to meet the county's water supply needs.)

During the design critical dry period, Santa Clara County's local water supply would be limited to approximately 135,000 af. Imported supplies that the District has contracted for would be greatly reduced to meet environmental requirements for flows into the Sacramento/San Joaquin Delta: the three imported supplies into the county would deliver an estimated total of 173,500 af, which is only slightly more than half of the County's contracted amount. The CVP M&I Shortage Policy has increased the District's imported reliability by 35,000 af during a critical dry period for a total imported amount of 208,500 af.

The estimated water needs of the county vary with the amount of rainfall and ambient temperature. For the dry and hot conditions that can be typical during critical dry periods, the water needs of the county are projected to be 537,000 af in the year 2020.

Comparison of available supplies and the critical dry period water needs of the county reveals a shortfall of 193,500 af. This shortfall can be only partly alleviated by the storage capacity of the District's current system. Effective management of the water utility by storing water when it is available and using this stored water during dry periods can reduce this shortfall to 175,000 af. If the District is to accomplish its primary goal of providing an adequate quantity and quality of water to the county, this critical dry period shortfall must be addressed and alternatives must be pursued.

WHAT IS AN INTEGRATED RESOURCE PLAN?
An IRP strives to achieve many water-related objectives: reliable water service, water reuse, conservation, reliable water quality, and environmental protection. It considers all direct and indirect costs and benefits of demand-side management, new sources of supply, supply-side management, modifications to the existing system operation, and societal and environmental benefits. The IRP process involves the community in planning, decision making, and implementation, with the goal of developing consensus for future water supply alternatives.

The American Water Works Association defines an IRP this way: "A comprehensive approach to evaluating supply-side and demand-side resource alternatives with respect to explicitly defined and often conflicting objectives. IRP encompasses least-cost planning, but is broader in its emphasis on an open and participatory decision-making process, the use of planning scenarios that incorporate variations in uncertainty and externalities, and consideration of multiple institutions concerned with water resources and the competing policies among them."

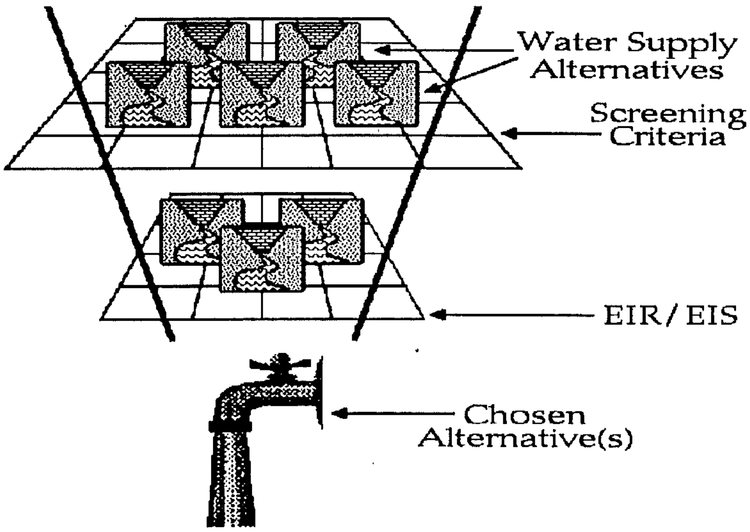
SCREENING CRITERIA

The goal of an IRP is to determine the criteria that are important to all stakeholders in the community. By developing screening criteria on different factors such as reliability, environmental considerations, and economics, stakeholders can come to agreement on many conflicting objectives. Screening criteria will help the community answer the following questions:

- What level of service do we need?
- How reliable must that service be?
- What types of economic and environmental impacts can we accept?

Figure 13.1 shows graphically how the screening criteria would work to evaluate numerous alternatives by filtering them through coarse, and then finer, screens. The result is a manageable number of alternatives for further evaluation in an EIR.

FIGURE 13.1
Integrated Resource Plan Screening Process



The following criteria could be applied to the water supply alternatives described in this report:

Level of Service

This criteria has three main components: supply reliability, system reliability, and water quality reliability.

- *Supply Reliability*—The District's local supplies are extremely variable; its imported supplies are even more vulnerable. The objective of this criteria is to determine the acceptable level of service to the District's retailers and the county's consumers under various hydrologic conditions.

- *System Reliability*—Major risks to the District's local and imported water supply systems include earthquake damage to the Rinconada WTP with resulting lack of service to the west side of the county, and earthquake damage to the District's imported water conveyance facilities and resulting loss of all or some imported supplies. Distribution modeling and system simulations must be analyzed and geotechnical work undertaken to define the severity and the duration of potential outages, and thus characterize the reliability of the District's current system. The water supply alternatives that store more water locally would provide greater system reliability.

- *Water Quality Reliability*—A fundamental goal of the District has been to provide high-quality water that meets federal and state water quality standards. Many water quality issues confront the District; pilot plant studies are underway to evaluate these issues and determine the District's response. Alternatives that expand treatment plant capacity or add a new plant will have to meet water quality requirements and will probably be expensive to construct and operate.

Potential Risks: Conservation, Reclamation, Regulation

Conservation and reclamation are major components of any of the alternatives that have been presented in this report. However, they both have uncertain market penetration. Variations in conservation and reclamation program effectiveness must be evaluated on an ongoing basis; other component resources may have to be modified in response to conservation/reclamation trends.

Regulations have been a major impact to available supplies. Future regulatory and political constraints due to health standards, environmental requirements, and other concerns could limit the District's ability to serve the county. The EPA's proposed Delta standards have given better definition on the District's imported supplies, but these regulations will certainly be changed in the future. These uncertainties must be addressed in analysis of all water supply alternatives.

Economic Considerations

Each resource alterative must be evaluated to determine the impact it has on the District's basic-user rate and the rate consumers pay for water. Rate studies must be made for each alternative. In addition to these studies, consumers must be solicited to determine the level of rate increase that they would accept for a water supply system that was more reliable.

Environmental Considerations

The impact of each resource alternative must be evaluated for environmental enhancements and degradations. For example, desalination offers an abundant source of water for the future, but could have very severe environmental impacts: enormous energy is needed to desalinate water, and the heavy metals that concentrate in the brine could pose a disposal problem.

Institutional Considerations

The differing needs of federal, state, and local agencies must be incorporated into all resource mixes and evaluated against the District's directive of supplying water to the community. The state Department of Fish and Game would like to enhance fish habitat by having water flow from the top of the watershed to the Bay. This will cause a direct reduction in local supplies and could require more imported water that would have an impact in the Delta.

Technical Feasibility

All of the resources must be evaluated for technical feasibility. One technical uncertainty is whether appliances that have not yet been developed will use water more efficiently than those currently in use.

Public Acceptance

The success of any of the alternatives will depend upon public acceptance. One of the key questions is whether the public will accept the recharge of reclaimed water as a source of potable supply. Unlike Southern California, the Bay Area has shown some resistance to this potential source of supply. For example, when IBM proposed to recharge the water it had pumped out of the groundwater basin and treated, the Toxics Coalition believed the recharge posed a major health effects problem and developed enough public support to stop the project.

FUTURE WORK

The following steps must be taken to develop a mix of resource alternatives that would receive public consensus and result in a reliable water supply for Santa Clara County.

1. **Establish Need**

   District staff believes this report establishes the need to augment the current water supplies of the county. This report should be disseminated to the District's water retailers, local and county government, environmental groups, the media, and concerned citizens for their comment.

2. **Involve the Community**

   Organize a citizen's group that represents the various interests of the community to provide the District with diverse voices.

3. **Develop Alternatives**

   This report has documented the evaluation of several different alternative combinations to meet the future water needs of the county. Additional resource alternatives may have to be developed as the IRP process evolves.

4. **Establish Screening Criteria**

   With the participation of all of the groups, develop screening criteria that will be used to objectively evaluate the numerous alternatives that can meet the level of service required.

5. **Screen Alternatives**

   Using the criteria that are established screen the alternatives to select those that will be evaluated in an EIR/EIS process.

6. **Build Board Consensus**

   Keep the District's Board of Directors abreast of the progress of the project and build consensus with them on the preferred alternatives throughout all of the steps taken.

7. **Undertake an EIR/EIS**

   The purposes of an EIR/EIS are to inform decision makers and the public about a project's significant environmental effects and ways to reduce them, demonstrate to the public that the environment is being protected, and ensure political accountability by disclosing to citizens the environmental standards held by their elected and appointed officials. Developing consensus in the IRP process should make this effort much easier. However, the entire environmental clearance and permit process usually takes a minimum of 2 to 4 years.

8. **Implement the Preferred Alternative**

   After all of the above steps are taken, the preferred alternative can be implemented.

SUMMARY

IRP offers the District an opportunity to involve various community stakeholders in the selection of the water supply alternatives that will be necessary to alleviate the county's projected water shortfall. The District would act as technical advisor and facilitator for this process, rather than as an advocate for a single alternative.

Through the IRP process, various community interests work together to develop screening criteria for evaluating supply alternatives. The screening criteria would be used to select a manageable number of alternatives for further study in an EIR. These criteria could address such factors as water supply and water quality reliability, vulnerability to regulatory changes, costs, environmental concerns, institutional considerations, technical feasibility, and public acceptance.